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“I would never have done it if it hadn’t been digital”: A qualitative study on expectations and experiences of a digital management program for hip and knee osteoarthritis

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7 **“I would never have done it if it hadn’t been digital”: A qualitative study on**
8 **expectations and experiences of a digital management program for hip and**
9 **knee osteoarthritis**
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ABSTRACT

Objectives

To investigate the expectations and experiences of a digital management program for hip and knee OA, including education and exercises as well as asynchronous chat with an assigned physical therapist for feedback, questions and support.

Setting

This study was conducted at a regional hospital in the southern part of Sweden.

Methods

Nineteen patients (10 women), median age 66 (q1-q3, 57-71) years, with confirmed hip or knee OA were interviewed after completing their first six weeks in the program, using a semi-structured interview guide. The interviews were transcribed verbatim and were qualitatively analyzed using systematic text condensation.

Results

Three categories emerged during the interviews:

1) *Management options for mitigating the consequences of OA*; 2) *Experiences of the design and exercises within the program* and 3) *Perceived effects of the digital program over time, and suggested improvements*. The participants had mostly positive experiences of the program. Particularly important for these experiences were no waiting list, the flexibility of taking part in the program with regards to location and time, and the possibility to have daily contact with a physical therapist. These aspects were also emphasized as advantages compared to traditional care.

Conclusions

Digital management of OA, including education and exercise, was experienced as a valid alternative to traditional treatment in enabling the implementation of OA guidelines in a wider community. Easy access, exercising at one's own convenience, flexible options, daily follow-up and support by a physical therapist were mentioned as the most important features. In addition, the results will contribute to further development and improvement of digital OA management programs.

For peer review only

Strengths and limitations of this study

- Participants were purposefully selected, including both sexes, who differed in age, OA severity and physical function in order to have rich and varied data to being able to evaluate shared pattern across cases.
- The use of a systematic text condensation analysis method facilitated cross-case synthesis of text and meaning
- Conducting the interviews via telephone may have resulted in less depth of the interviews due to a loss of visual input

BACKGROUND

Due to a combination of decreasing healthcare resources, long waiting lists, and limited options to meet the demands of the modern individual who often has a busy schedule, the use of web-based or digital management options in healthcare, so-called e-health, has increased significantly during the last decade [1-3]. Accessibility and flexibility, social motives and an option for anonymity and confidentiality are common arguments for choosing e-health [4-10].

Several digital management programs that incorporate web-based cognitive behavioral therapy have been developed for different conditions, such as anxiety [1], psoriasis [2, 11], and eating disorders [3], with promising results. A recent review also suggests that it may be easier to seek care and to incorporate the training into daily life when it is accompanied by the flexibility and anonymity that online delivery provides, and that some people even rated their relationship with the online-therapist higher than their relationship with their ordinary therapist [6]. However, web-based or digital management for musculoskeletal disorders have thus far not been studied to any great extent [14].

Individuals with osteoarthritis (OA) constitute one group of patients for whom e-health may be highly beneficial [4, 14]. As concluded previously in various literature, the guidelines for OA treatment (education, exercise and weight management) are not always implemented and few individuals with OA receive adequate management [4, 15, 16]. Lack of healthcare resources, living in rural areas, and having a lower level of education are all factors that may reduce the likelihood of receiving appropriate information on management options for OA

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2
3 [4, 16]. Web-based or digital interventions for OA have been suggested as a way to make the
4
5 availability of guideline-based OA management accessible to a wider community [4, 14, 17]
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8 and a few studies have shown promising results of e-health interventions on pain and
9
10 physical function in patients with hip or knee OA [14, 17-20].
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16 Joint Academy [21], was developed in Sweden and is a digital version of the evidence-based
17
18 face-to-face self-management program *Better Management of Patients with OsteoArthritis*
19
20 (BOA) [15, 22]. The program comprises OA education (instructional videos on OA, physical
21
22 activity and weight management), individualized neuromuscular exercises with increasing
23
24 difficulty, and an option to chat asynchronously with an assigned physical therapist for
25
26 feedback and questions. Studies have shown that completing the introduction phase of six
27
28 weeks in this digital OA management program reduces pain and medication intake, increases
29
30 physical function and walking ability, as well as reduces the willingness for surgery [18, 19,
31
32 23]. However, patient experience of digital management for OA has not yet been evaluated.
33
34 This knowledge may help to further improve e-health as a management option for OA and to
35
36 facilitate the implementation of OA guidelines in a wider community. Thus, the aim of this
37
38 qualitative study was to investigate the expectations and experiences of a digital
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40 management program in patients with hip or knee OA.
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51 **METHOD**

52 **Setting and sampling**

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54 This study was conducted at a regional hospital in the southern part of Sweden. From a total
55
56 sample of 462 individuals that had completed six weeks in the digital OA management
57
58 program between 2015 and 2018, 73 invitations with written information about the study
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1
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3 were sent out by e-mail. The inclusion criterion was hip or knee OA, previously confirmed or
4
5 diagnosed by an orthopedic surgeon involved in the program and the exclusion criteria were
6
7
8 i) reporting other joints than hip or knee as the primary joint for OA symptoms, and ii) not
9
10 understanding and/or speaking Swedish. The participants were purposefully selected in
11
12 order to represent both sexes, different age groups, perceived pain and physical function
13
14 [24]. Twenty-one participants accepted the invitation to participate in this study. Two were
15
16 excluded as one did not speak Swedish and one did not return our phone calls. Ten women
17
18 and nine men, median age 66 (q1-q3, 57-71) years were consecutively included in the study.
19
20 Their primary OA joint location was either in the knee (48%) or hip (52%). All participants in
21
22 this study completed the program via stationary computers, laptops or mobile phones. The
23
24 Regional Ethical Review Board in Lund, Sweden (Dnr 2017/651; Dnr 2017/980) approved the
25
26 study and all patients gave their written informed consent prior to participation.
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36 Data collection

37 The interviews were conducted by two of the authors (JE & AC), either as face-to-face
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39 interviews, by Skype or by telephone, depending on the participant's location and access to
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41 Skype. The semi-structured interview guide included areas of interest such as 1) experiences
42
43 of living with OA, 2) expectations of the management program before participating, 3)
44
45 experiences of the digital management program, and 4) experiences of factors that may
46
47 have increased their motivation, persistence and emotional reactions. In addition, the
48
49 participants were asked to suggest possible improvements to the program. Follow-up
50
51 questions were used to encourage the participants to elaborate on the subject and to
52
53 explain or clarify the meaning and consequences of their experiences. The interview guide
54
55 and follow-up questions were pilot tested and was then subjected to minor editing. The
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3 interviews, which lasted approximately 30-40 minutes, were recorded and transcribed
4
5 verbatim. The transcripts were analyzed using systematic text condensation (STC) according
6
7 to Malterud [25], which is based on Giorgi's phenomenological analysis [26]. STC was chosen
8
9 as the procedure facilitates cross-case synthesis of text and meaning [25]. Data collection
10
11 stopped when no further information was added. See Appendix 1 for interview guide.
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18 **Data analysis**

19 First, the interview transcripts were read to get a general impression of the whole and to
20
21 identify primary themes. Then, meaning units were identified and formulated into codes
22
23 that represented the core of the statements. During this phase, three of the authors (JE, AC,
24
25 and CSH) worked individually to identify as many perspectives and perceptions as possible in
26
27 the material. Next, all authors worked together with the coded data to produce one set of
28
29 data, extracting duplicates and data that were not relevant for the aim of the study. The
30
31 coded data were then organized into subcategories, and the content of the meaning units of
32
33 each category was re-examined. The meaning and representation of the data was
34
35 formulated into aspects representing the content. Thereafter, the subcategories were
36
37 organized into categories. To validate the categories and make sure that no important
38
39 aspects had been overlooked, the clusters were referred back to the raw data, and read
40
41 through once again by the authors. Finally, the re-contextualized data was expressed as
42
43 interpretations of the meaning of each category and representative quotes were selected for
44
45 each category/subcategory.
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57 **RESULT**

58 Three categories were uncovered during the analysis:
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3 1) Management options for mitigating the consequences of OA, with two sub-categories a)
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5 Consequences of OA on everyday life and b) Expectations when joining the digital program.
6
7

8 2) Experiences of the design and exercises within the program, with four sub-categories a)
9
10 Easy to execute, b) Flexibility to choose when and where, c) The importance of interacting
11
12 with healthcare professionals and d) Other motivating factors. 3) Perceived effects of the
13
14 digital program over time, and suggested improvements, with three subcategories a)
15
16 Perceived effects of the program after the initial six weeks, b) Reasons for continuing to
17
18 participate in the program and c) Suggestions for improving the digital program.
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25 **Management options for mitigating the consequences of OA**

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27 This category entailed the experiences of the perceived consequences of OA and the
28
29 desirous search for a cure that would reduce their symptoms. All participants
30
31 experienced severe pain and decreased physical function prior to joining the digital
32
33 program. They were eager to try any treatment hoping that the program could
34
35 reduce their symptoms and improve their quality of life.
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43 **Consequences of OA on everyday life**

44 The participants described symptoms such as pain, disrupted sleep, deteriorating ability to
45
46 walk, being immobile, and activity limitations. Pain was the main motivation for seeking
47
48 professional management. The participants also found that their decreased functioning was
49
50 not only affecting themselves, but was also a burden on their partners and family. They were
51
52 trying all sorts of ways to ease the pain and to regain motor function.
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1
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3 *"I felt that it was impossible to continue in this way as I was in such intense pain..."*
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5

6 (I18)
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10 **Expectations when joining the digital program**

11 When joining the digital program, most participants expressed that they were expecting
12
13 improvements in terms of reduced OA symptoms, such as reduced pain, and improved
14
15 flexibility and function to better cope with their everyday life. Generally, they did not expect
16
17 to be fully cured, but were anticipating to get better, or at least, not worse. However, a few
18
19 participants expressed that they had none or little faith in the management program. They
20
21 explained that they had signed up mostly out of curiosity to see if this program may help
22
23 them, since all former management options had failed to reduce their symptoms.
24
25
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31

32 *"The expectations that I had were to be more flexible and to reduce the pain.*

33
34 *That was how I figured it could be."* (I18)
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39 **Experiences of the design and exercises within the program**

40 In general, the participants' experiences of the program were positive. They found the
41
42 program very easy to execute, flexible, and motivational. The interaction with the physical
43
44 therapist was described as important for support and encouragement.
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50 **Easy to execute**

51 Most participants were satisfied with the set-up of the program. The program was perceived
52
53 as structured, educational, and very simple to execute. Other elements that facilitated
54
55 participation were instructional videos, email reminders, and that the exercises were
56
57 individually customized with increasing difficulty, but also quickly accomplished.
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4 *"This is such a great set-up. Not only the exercises, it's really educational and you*
5 *learn what osteoarthritis is really about."* (I13)
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11 *"I found it really easy to follow. It does not take long and it's really good to*
12 *receive these reminders by email"* (I18)
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18 However, a few participants perceived some difficulties in understanding how the program
19 worked. They found that the progression of the exercises was not clearly described or that it
20 was difficult to understand specific words used in the videos.
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27
28 *"To me it was hard to follow in the beginning and it actually took some time*
29 *before I understood it correctly. It took like a few weeks until I really got the*
30 *system. And that was a pity I think."* (I8)
31
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39 *Flexibility to choose when and where*

40 All participants acknowledged the flexibility that was associated with this digital
41 management program. The ability to execute the exercises at home, or at any place at any
42 time, without any use of equipment was highly appreciated. The ability to control the time
43 point for when to perform the exercises and not having to make a scheduled appointment at
44 a specific location, were described as an advantage compared to traditional management,
45 and were further expressed as time-saving and less stressful since participants did not have
46 to take time off from work for OA management. One participant even expressed that she
47 would never have completed such a program if it had not been digital.
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3 *“The flexibility, that I could decide on my own when to perform the exercises was*
4 *really good. That I didn’t have any scheduled time point when I had to dress, go*
5 *out, and at this exact time point meet a physical therapist. That I could decide on*
6 *my own...” (I11)*
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14
15 *“I don’t think this is bad at all, to have it on the internet like this. I would never*
16 *have done it if it hadn’t been digital” (I17)*
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22
23 Some participants described that there were long waiting lists for traditional OA
24 management in primary care and that the digital program was, thus, a flexible alternative
25 that they could start at once.
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31 *“Yes, it was also like, there was such a long waiting list for primary care. So I*
32 *thought...this,...this I can start doing right away.” (I10)*
33
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39 *The importance of interacting with healthcare professionals*

40 Receiving an OA diagnosis without any physical meeting was perceived as a bit awkward to
41 some participants. Some concerns were revealed regarding the risk of missing serious
42 diseases if the diagnosis was given by phone or internet.
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50 *“It’s somewhat hard to give a diagnosis over the phone. You can do it, but it’s*
51 *more difficult and you can miss things... there could have been a tumor there...”*
52
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54
55 (I14)
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3 The majority of the participants had a very positive experience of the interaction with their
4
5 online physical therapist. They described that they received fast responses to their
6
7 questions, as well as information and encouragement, and that they often received feedback
8
9 within a few hours. Some expressed that the engagement from their physical therapist was
10
11 valuable for support and encouragement, especially if they experienced pain during the
12
13 exercises. The daily contact with their physical therapist encouraged them to perform their
14
15 exercises every day, which was also perceived as an advantage compared to traditional care
16
17 management.
18
19
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25 *“I think it’s excellent to have daily contact. I think it’s outstanding. That puts*
26
27 *pressure on me to really do these exercises and to answer him [the physical*
28
29 *therapist] and to give him an opportunity to give feedback and information about*
30
31 *other things... You can’t go to a physical therapist every day, every day, every*
32
33 *day. That won’t work. They won’t have time for me, they have others to take care*
34
35 *of as well. “ (I12)*
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42 In contrast, some participants experienced the contact with their online physical therapist to
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44 be unsatisfactory or even non-existent. They described that it could take a week before they
45
46 received any response, that the questions were only partly answered, or that they received
47
48 no answer at all. Continuous follow-up with feedback and encouragement on their
49
50 performance in the program was also lacking.
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56 *“In the beginning they said that someone would get in touch with me on a*
57
58 *regular basis and things like that. But this hasn’t happened as I expected” (I9)*
59
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Other motivating factors

The daily email reminders were typically highlighted as a motivator since they ensured that participants did not forget about the exercises and pushed them to perform the activities every day. Improved OA symptoms, and the measurement feedback system provided by the program were other factors that were mentioned as contributing to the participants' motivation to perform the exercises.

"It was there, popped up in my email box every day. OK, today I'll do this exercise...it was something that pushed me. That was good I think...I needed that." (I8)

Perceived effects of the digital program over time and suggested improvements

The majority of the participants reported improved functioning and reduced pain.

However, some people felt no improvements and that their symptoms were the same as before entering the program. Many continued to participate in the program after the initial six weeks to maintain the positive improvements. Although the participants were positive to the digital program, they suggested a broader variation of exercises as well as follow-ups by video calls.

Perceived effects of the digital program after the initial six weeks

Several participants experienced significant reductions in OA symptoms after completing the program. Improvements commonly mentioned were reduced pain, increased flexibility, and improved walking abilities. In many cases the symptoms were still present but were

1
2
3 perceived to have improved significantly, leading to increased quality of life and less focus
4
5 on the disease. Many described that they had recommended the program to friends and
6
7 relatives suffering from hip or knee OA, since they were satisfied with the result and wished
8
9 that more people could undergo the same management program.
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15 *“It has helped me fantastically. I don’t think I could have walked the way I do*
16
17 *today if I hadn’t done this... I don’t think so... I think this program has had an*
18
19 *absolute crucial role in the fact that I can manage my everyday life as well as I*
20
21 *can now, even though I have quite big problems.” (I2)*
22
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29 Not all participants perceived that they had reduced symptoms or improvements after six
30
31 weeks in the program. Some described that their symptoms were still the same or had
32
33 initially improved, and then worsened with deteriorating physical function and increased
34
35 pain. However, several of these participants still believed in the set-up despite not
36
37 experiencing the results they wished for. This lack of positive results was attributed to a
38
39 belief that they entered the program too late, i.e., that the exercises might have helped if
40
41 they had started at an earlier stage of the disease, or that the exercises may have slowed
42
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46 down the disease progression.
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50 *“The sad thing is that even if I do these exercises, every day, every week, every*
51
52 *month, every year... nothing happens... I don’t get any better.” (I4)*
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3 *"It felt really good in the beginning. The reason that it didn't help me is probably*
4 *because I started too late."* (I12)
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10 11 *Reasons for continuing to participate in the program*

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13 Many continued to do their exercises after the six weeks evaluation. Perceived functional
14 improvements and pain reduction as well as fear of the symptoms worsening were highly
15 motivating factors for continuing to perform the exercises. Another reason was that it might
16 help them to be well prepared for any upcoming surgery.
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26 *"I believe in these exercises. I believe that exercise is good for osteoarthritis. I am*
27 *convinced. And I think... if I stop doing this... then this terrible pain will start*
28 *again."* (I8)
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35 On the other hand, reduced pain and scheduled surgery were described by some
36 participants as reasons for not continuing the program.
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43 *"The pain was generally reduced... and then I did not feel as motivated as before*
44 *so I quit doing the exercises... yes I did. Generally, in physical therapy, it's hard to*
45 *keep your motivation up if you don't have a lot of pain."* (I19)
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52
53 *"I have met with my orthopedist and I'm scheduled for surgery... I feel that the*
54 *end of this problem is near. That's why I'm not performing the exercises as I*
55 *should anymore."* (I18)
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Suggestions for improving the digital program

The participants suggested a few possible improvements to the digital program. For example, many experienced that there were too few exercises with little variation, and the exercises were perceived as somewhat monotonous after a while, especially if the participants were highly active in the program, i.e., carried out exercises several days a week. It was suggested that varying and/or adding more exercises would increase motivation to perform them.

“In the end it became a bit boring since there were so few movements... so I added some extra on my own... It was a bit boring to do the same thing every day.” (I14)

Some participants that were not satisfied with the communication with the online physical therapist suggested improved patient-physical therapist interaction using increased feedback and encouragement. Another suggestion included follow-ups video calls or Skype to enhance feedback on the individual performance of specific exercises

“You could send a video via internet and the physical therapist will then check that you have performed the exercise and performed it correctly and correct you if you have performed it incorrectly.” (I19)

DISCUSSION

We sought to investigate participant perspectives of a digital management program for hip and knee OA. The majority of the participants reported improvements after the initial six weeks, such as reduced pain, increased mobility, and a sense of improved quality of life. In general the participants found that the program was easy to execute. The flexibility of being able to perform the exercises anywhere and at any time point was highly appreciated. The daily contact with the physical therapist was considered very important and an advantage compared to traditional care and the participants felt that the support and encouragement they received was important to continue exercising.

Despite international guidelines [28], many patients with hip and knee OA do not receive appropriate treatment and information regarding OA management options [4, 15, 16]. Web-based or digital management programs have been proposed as an option for facilitating the implementation of non-surgical treatment as they have the potential to reach more individuals in need of OA treatment [4]. The participants in the current study were mostly positive to the set-up of the program. Being able to perform the exercises whenever and wherever they desired, without needing to take time off from work, was described as valuable. Several participants also mentioned that the digital program was something they could start doing right away instead of being put on a waiting list. They also experienced the program to be educational and they felt motivated by the daily email reminders and the feedback system that were provided by the program. This result is in line with previous studies investigating patient perceptions of digital OA management, e.g., through internet or tele rehabilitation, where the participants experienced such programs to be convenient and time-saving [29, 30].

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6 Exercise is one of the cornerstones of OA management [28]. However, the outcome of the
7
8 OA management program is highly dependent on adherence to the exercises, and people
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10 with OA seem to be among those with particularly poor adherence to this type of treatment
11
12 [31]. A recent systematic review of people with hip and knee OA identified factors such as
13
14 increased knowledge of the disease and benefits of exercise, reduced symptoms, easy access
15
16 to training facilities, and the ability to fit the exercises into daily life as facilitating exercise
17
18 participation, whereas long travel time and parking difficulties were considered as barriers
19
20 [32]. The results from the current study indicate that a digital program may facilitate
21
22 participation in OA management programs and eliminate some of the barriers associated
23
24 with exercise participation, and further highlights the importance of adequate information
25
26 and education regarding the benefits of exercise and different treatment options in OA. In
27
28 addition, a digital delivery also enables the patients to continue their treatment week after
29
30 week to further improvements and to sustain their achieved behavioral change.
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40 Previous research indicates that support and encouragement from healthcare staff are
41
42 important factors in facilitating exercise participation in people with hip and knee OA [32].
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44 This was also reflected in the current study. Interaction with the physical therapist was
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46 another important aspect that was highlighted by the participants. Most participants had a
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48 positive experience of the contact with their assigned physical therapist and they were
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50 highly motivated by the daily contact and the support and encouragement that were
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52 provided. This result further emphasizes previous findings that a strong therapeutic alliance
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54 can be established without meeting in person [33-35]. However, some participants were not
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56 satisfied with the contact, which in turn lowered their motivation to perform the exercises.
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3 This may indicate that support and encouragement from the physical therapist are
4 prerequisites for a satisfactory experience of a digital OA management program.
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10 In accordance with studies on tele rehabilitation, [29, 30], some concerns were expressed in
11 our interviews about being diagnosed online. A few patients were afraid that they may have
12 been suffering from a more serious disease, such as cancer, and that a differential diagnosis
13 may be difficult via the internet. It is therefore important to respond to these worries
14 accordingly, and provide the patients with information that explains that OA is primarily
15 diagnosed by symptoms and signs without any use of radiography or laboratory equipment
16 [36]. Also, some participants wished to have follow-ups via video call to eliminate the risk of
17 performing the exercises incorrectly. This is consistent with previous studies reporting that
18 non-supervised home-based exercises can give rise to concerns regarding the correct
19 performance of the exercises [5, 30, 37]. Video calls may, thus, be one way to develop the
20 program further and to optimize the experiences of digital programs without any physical
21 meeting. However, the influence of video conversations need further study.
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42 Many participants in this study reported improvements in symptoms and physical function,
43 such as reduced pain and improved walking ability. Interestingly, reduced pain and being
44 scheduled for surgery were two factors described as both facilitators and barriers to
45 continuing in the program. Some participants continued to exercise because they
46 experienced that the program had reduced their pain and they were afraid that the pain
47 would come back if they stopped doing the exercises. In contrast, some felt that reduced
48 pain was a reason to stop doing the exercises, as their motivation was lost when pain no
49 longer was an issue. Likewise, some participants continued to exercise since they wanted to
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3 be ready and “as fit as possible” for a total joint replacement (TJR), whereas others quit
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5 doing the exercises when they were scheduled for TJR as they believed the surgery would
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7 solve their problems anyway. Pre-surgery exercise is known to improve outcomes such as
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9 length of hospitalization, knee range of motion, and physical function after total knee
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11 replacements [38] and such information is, therefore, important to include in the
12
13 educational material to facilitate recovery after any future TJRs in these patients.
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19 One strength of this study is that the participants were purposefully selected, including both
20
21 men and women who differed in age, OA severity, physical function, and OA location (hip or
22
23 knee) from different parts of Sweden. However, since the participants were located all over
24
25 Sweden, the interviews were mostly conducted by telephone or via Skype. This approach
26
27 may have resulted in less depth of the interviews due to a loss of visual input. Also, two of
28
29 the participants completed the program more than one year prior to the interviews, which
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31 may have influenced their recollection of the program and thereby also the experiences
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33 expressed during the interviews.
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42 Throughout the data analysis reflexivity has been considered, i.e., we have been aware that
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44 the pre-understanding that the authors may have as clinicians and researchers could affect
45
46 the data, if one is not fully aware of previous experiences [39]. All authors worked separately
47
48 during the data processing and there were continuous discussions during the analysis aimed
49
50 at eliminating possible influences of previous experiences, which helped us to stay neutral to
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52 the data. In addition, we have also presented a signature after each quotation to show the
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54 representation of our participants, and to add transparency and trustworthiness to our
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56 findings and interpretations of the data.
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CONCLUSION

A digital management program for OA, including education and exercise as well as asynchronous chats with an assigned physical therapist for feedback, questions and engagement, may be an alternative to traditional treatment and further facilitate the implementation of OA guidelines in a wider community. The participants had mostly positive experiences of the program, the flexibility of the program with regards to location and time. Regular and frequent contact with a physical therapist was deemed particularly important for a positive experience of the program and was also emphasized as an advantage compared to traditional care. In addition, the result of this study will contribute to the further development and improvement of digital management for OA.

AUTHORS' CONTRIBUTION

Anna Cronström, PhD contributed to the design of the study, conducted part of the interviews, was responsible for the analysis and interpretation of the data, and was in charge of writing the manuscript. Leif E Dahlberg, PhD contributed to the conception and design of the study, contributed to the interpretation of the data, and provided feedback on drafts of this paper. Håkan Nero, PhD contributed to the conception and design of the study, contributed to the analysis and interpretation of the data, and provided feedback on drafts of this paper. Jennifer Ericson, BSc student contributed to the conception and design of the study, conducted part of the interviews, contributed to the analysis and interpretation of the data, and provided feedback on drafts of this paper. Catharina Sjö Dahl Hammarlund, PhD contributed to the conception and design of the study, contributed to the analysis and interpretation of the data, and provided feedback on drafts of this paper. All authors have read and approved the final manuscript.

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COMPETING INTEREST

HN is a physical therapist and part-time consultant at the specific OA management program, which was used in the present study and LED is the co-founder and Chief Medical Officer in the corporation behind the same program. No other relationships or activities exist that could appear to have influenced the submitted work.

DATA SHARING STATEMENT

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

PATIENT AND PUBLIC INVOLVEMENT STATEMENT

The Joint Academy treatment program for OA is based on the evidence-based BOA concept [15]. In addition to the interviews in the present study, the digital platform has previously been further developed and improved by analyzing questionnaires and opinions from patients recruited via the Swedish Rheumatism Association. These patients were able to test Joint Academy and were extensively interviewed about their opinions. All other aspects of this research were performed without patient involvement. Patients were not invited to comment on the study design and were not consulted to develop patient-relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

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3 **Interview guide - Experiences of a digital management program for hip and knee**
4 **osteoarthritis** (translated from the Swedish version)
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8 How long have you had symptoms from your hip/knee?
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10 Could you describe your symptoms before joining the program?
11

- 12
- 13 • How did your symptoms affect you everyday life?

14 What were your reasons for joining the program?
15

16 What were your expectations before joining the program?
17

18 How did you experience the treatment?
19

- 20
- 21 • Set-up
 - 22 • Exercises
 - 23 • Availability
 - 24 • Layout
- 25

26 How was your motivation for doing the activities?
27

28 How did you experience your contact with the physical therapist?
29

30 Do you experience that the treatment has altered your symptoms?
31

- 32
- 33 • In what way/direction?

34 Have you continued with the program/home exercises after the initial six weeks?
35

- 36
- 37 • What were your reasons/motivations for continue/not continue?
- 38

39 How do you think Joint Academy could have done a better job in assisting your treatment?
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44 At the end of the interview asking the participant to raise any subject not yet covered
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46 Throughout the interview the participants were asked to elaborate on the subject and to
47 explain or clarify the meaning and consequences of their experiences
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COREQ (CONsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			NA
<i>Personal characteristics</i>			
Interviewer/facilitator	1	JE & AC	7 & 22
Credentials	2	JE:BSc student, AC: PhD	22
Occupation	3	JE:Physiotherapy student, AC: Researcher	22
Gender	4	JE & AC: Female	
Experience and training	5	Basic training	7
<i>Relationship with participants</i>			
Relationship established	6	No relationship	NA
Participant knowledge of the interviewer	7	All participants had oral and written information which included that the data collection was part of her Bachelor thesis and future scientific publications.	6-7
Interviewer characteristics	8	JE & AC showed interest and empathy and gave relevant follow-up questions to encourage the participants to elaborate on their narratives.	
Domain 2: Study design			
<i>Theoretical framework</i>			
Methodological orientation and Theory	9	Systematic text condensation as described by Malterud, which is based on Giorgis' psychological phenomenological analysis (ref 21,22)	8
<i>Participant selection</i>			
Sampling	10	The participants were purposefully selecteddifferent age groups, perceived pain and physical function They were consecutively included...	6-7
Method of approach	11	Seventy three invitations with written information about the study were sent out by e-mail. Twenty-one accepted the invitation.	6
Sample size	12	Nineteen participated...	7
Non-participation	13	Two were excluded. One did not speak Swedish, one could not be reached.	7
<i>Setting</i>			
Setting of data collection	14	Mostly in their homes using Skype or telephone, two personal interviews	7
Presence of non-participants	15	None else were present besides the participants and researchers.	NA
Description of sample	16	Ten women and nine men, median age 66 (q1-q3, 57-71) years, OA joint location was either in the knee (48%) or hip (52%).	7
<i>Data collection</i>			
Interview guide	17	The interview guide and follow-up questions were pilot tested and were then subjected to minor editing.	7
Repeat interviews	18	No repeat interviews were carried out	NA
Audio/visual recording	19	The interviews were recorded.	8
Field notes	20	Field notes was taken with regard to emotinal reactions and so on.	
Duration	21	The duration was approximately 30-40 minutes.	8
Data saturation	22	Data collection stopped when no further information was added.	8
Transcripts returned	23	The transcripts were not returned to participants for comment and/or	NA

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction.	
Domain 3: analysis and findings			
<i>Data analysis</i>			
Number of data coders	24	Three authors coded the data (JE,AC,CSH)	8
Description of the coding tree	25	The coding tree was not provided.	NA
Derivation of themes	26	The themes derived from the data.	8
Software	27	No software was used to manage the data.	NA
Participant checking	28	The participants did not provide feedback on the findings.	NA
<i>Reporting</i>			
Quotations presented	29	Participant quotations was presented to illustrate the findings and each quotation was identified with a signature.	21
Data and findings consistent	30	The data was rich, varied and consistent. No triangulation was done.	21
Clarity of major themes	31	Major themes were clearly presented in the findings.	8-17
Clarity of minor themes	32	There is a description of diverse cases and discussion of minor themes.	18-21

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.

BMJ Open

I would never have done it if it hadn't been digital": A qualitative study on patients' experiences of a digital management program for hip and knee osteoarthritis in Sweden

Journal:	<i>BMJ Open</i>
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Primary Subject Heading:	Rehabilitation medicine
Secondary Subject Heading:	Rehabilitation medicine
Keywords:	osteoarthritis, e-health, non-surgical management

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7 3 **“I would never have done it if it hadn’t been digital”: A qualitative study on**
8 **patients’ experiences of a digital management program for hip and knee**
9 **osteoarthritis in Sweden**
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13 6 Anna Cronström¹, Leif E Dahlberg^{1, 2}, Håkan Nero¹, Jennifer Ericson³, Catharina Sjö Dahl
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40 18 **Keywords:** e-health; digital management; osteoarthritis
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19 ABSTRACT

20 Objectives

21 To investigate the experiences of a digital management program for hip and knee
22 osteoarthritis (OA), including education and exercises as well as asynchronous chat with an
23 assigned physical therapist for feedback, questions and support.

24 Setting

25 This study was conducted at a regional hospital in the southern part of Sweden.

27 Methods

28 Nineteen patients (10 women), median age 66 (q1-q3, 57-71) years, with confirmed hip or
29 knee OA were interviewed after completing their first six weeks in the program, using a
30 semi-structured interview guide. The interviews were transcribed verbatim and were
31 qualitatively analyzed using systematic text condensation.

33 Results

34 Three categories emerged during the interviews:

35 1) *Management options for mitigating the consequences of OA*; 2) *Experiences of the digital*
36 *program* and 3) *Perceived effects of the digital program over time*. The participants had
37 mostly positive experiences of the program. Particularly important for these experiences
38 were no waiting list, the flexibility of taking part in the program with regards to location and
39 time, and the possibility to have daily contact with a physical therapist. These aspects were
40 also emphasized as advantages compared to traditional care.

42 Conclusions

43 Digital management of OA, including education and exercise, was experienced as a valid
44 alternative to traditional treatment in enabling the implementation of OA guidelines in a

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45 wider community. Easy access, exercising at one’s own convenience, flexible options, daily
46 follow-up and support by a physical therapist were mentioned as the most important
47 features. In addition, the results will contribute to further development and improvement of
48 digital OA management programs.

For peer review only

52

Strengths and limitations of this study

- Participants were purposefully selected, including both sexes, who differed in age, osteoarthritis severity and physical function in order to have rich and varied data, when synthesizing shared patterns across cases
- The use of a systematic text condensation analysis method facilitated cross-case synthesis of text and meaning
- Conducting the interviews via telephone may have resulted in less depth of the interviews due to a loss of visual input, but also allowed inclusion of participants from a wide geographic area.

53 BACKGROUND

54 Due to a combination of decreasing healthcare resources, long waiting lists, and difficulty to
55 meet the demands of the modern individual who often has a busy schedule, the use of web-
56 based or digital management options in healthcare, has increased significantly during the
57 last decade [1-3]. Accessibility and flexibility, social motives and an option for anonymity and
58 confidentiality are common arguments for choosing digital options [4-10]. A recent review
59 also suggests that it may be easier to seek care and to incorporate the training into daily life
60 when it is accompanied by the flexibility and anonymity that online delivery provides, and
61 that some people even rated their relationship with the online-therapist higher than their
62 relationship with their ordinary therapist [6]. However, web-based or digital management
63 for musculoskeletal disorders have thus far not been studied to any great extent [11].

64
65 Individuals with osteoarthritis (OA) constitute one group of patients for whom digital
66 management may be highly beneficial [4, 11]. As concluded previously in various literature,
67 the guidelines for OA treatment (education, exercise and weight management)[12] are not
68 always implemented and few individuals with OA receive adequate management [4, 13, 14].
69 Lack of healthcare resources, living in rural areas, and having a lower level of education are
70 all factors that may reduce the likelihood of receiving appropriate information on
71 management options for OA [4, 14]. Web-based or digital interventions for OA have been
72 suggested as a way to make the availability of guideline-based OA management accessible to
73 a wider community [4, 11, 15]. Unlike in patients with inflammatory arthritis where digital
74 management does not seem to increase physical activity or quality of life [16], a few studies

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3 75 have shown promising results of digital interventions on physical activity [17], pain and
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6 76 physical function in patients with hip or knee OA [11, 15, 18-20].
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12 78 Joint Academy [19, 21, 22], was developed in Sweden and is a digital version of the evidence-
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14 79 based face-to-face self-management program *Better Management of Patients with*
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16 80 *OsteoArthritis* (BOA) [13, 23]. The program, as thoroughly described previously [19],
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18 81 comprises OA education (instructional videos on OA, physical activity and weight
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20 82 management), individualized neuromuscular exercises with increasing difficulty aiming at
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22 83 improving lower extremity strength and neuromuscular control, and an option to chat
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24 84 asynchronously with an assigned physical therapist for feedback and questions. Studies have
25
26 85 shown that completing the introduction phase of six weeks in this digital OA management
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28 86 program reduces pain and medication intake, increases physical function and walking ability,
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30 87 as well as reduces the willingness for surgery [18, 19, 24]. However, patient experience of
31
32 88 digital management for OA has not yet been evaluated. This knowledge may help to further
33
34 89 improve digital management options for OA and to facilitate the implementation of OA
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36 90 guidelines in a wider community. Thus, the aim of this qualitative study was to investigate
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38 91 the patients' experiences of using a digital management program for hip and knee OA.
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93 **METHOD**

94 **Patient and public involvement statement**

95 The Joint Academy treatment program for OA is based on the evidence-based BOA concept
96 [13]. In addition to the interviews in the present study, the digital platform has previously
97 been further developed and improved by analyzing questionnaires and opinions from
98 patients recruited via the Swedish Rheumatism Association. These patients were able to test

1
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3 99 Joint Academy and were extensively interviewed about their opinions. All other aspects of
4
5
6 100 this research were performed without patient involvement. Patients were not invited to
7
8 101 comment on the study design and were not consulted to develop patient-relevant outcomes
9
10
11 102 or interpret the results. Patients were not invited to contribute to the writing or editing of
12
13 103 this document for readability or accuracy.

14
15 104

17 105 **Setting and sampling**

18 106 This study was conducted at a regional hospital in the southern part of Sweden. From a total
19
20
21 107 sample of 462 individuals that had completed six weeks in the digital OA management
22
23
24 108 program between 2015 and 2018, 73 invitations with written information about the study
25
26 109 were sent out by e-mail by the first author (AC). The inclusion criterion was clinical hip or
27
28
29 110 knee OA, previously confirmed or diagnosed according to the ACR criteria [25, 26] by an
30
31 111 orthopedic surgeon involved in the program. The exclusion criteria were i) reporting other
32
33
34 112 joints than hip or knee as the primary joint for OA symptoms, and ii) not understanding
35
36 113 and/or speaking Swedish. The participants were purposefully selected in order to represent
37
38
39 114 both sexes, different age groups, perceived pain and physical function [27]. Twenty-one
40
41 115 participants accepted the invitation to participate in this study. Two were excluded as one
42
43
44 116 did not speak Swedish and one did not return our phone calls. Ten women and nine men,
45
46
47 117 median age 66 (q1-q3, 57-71) years were consecutively included in the study. Their primary
48
49
50 118 OA joint location was either in the knee (48%) or hip (52%) (See Table 1 for participant
51
52
53 119 characteristics). All participants in this study completed the program via stationary
54
55
56 120 computers, laptops or mobile phones. The Regional Ethical Review Board in Lund, Sweden
57
58 121 (Dnr 2017/651; Dnr 2017/980) approved the study and all patients gave their written
59
60 122 informed consent prior to participation.

123

124 **Data collection**

125 The interviews were conducted by two of the authors (JE & AC), either as face-to-face
126 interviews, by Skype or by telephone, depending on the participant's location and access to
127 Skype. The semi-structured interview guide included areas of interest such as 1) experiences
128 of living with OA, 2) prior experiences of OA management, 3) experiences of the digital
129 management program (e.g., set-up, educational contents, feed-back, feed-forward,
130 availability and design), and 4) experiences of factors that may have increased their
131 motivation, persistence and emotional reactions. In addition, the participants were asked to
132 suggest possible improvements to the program. Follow-up questions were used to
133 encourage the participants to elaborate on the subject and to explain or clarify the meaning
134 and consequences of their experiences. The interview guide and follow-up questions were
135 pilot tested on three older individuals with OA, not included in the study and was then
136 subjected to minor editing. The interviews, which lasted approximately 30-40 minutes, were
137 recorded and transcribed verbatim. Data collection stopped when no further information
138 was added. See Appendix 1 for interview guide.

139

140 **Data analysis**

141 The transcripts were analyzed using systematic text condensation (STC) according to
142 Malterud [28], which is based on Giorgi's phenomenological analysis [29]. The procedure of
143 the analysis consists of the following steps: 1) creating an overall impression and identifying
144 themes; 2) distinguishing and sorting meaning units to codes; 3) formulating the meaning of
145 each code meaning and 4) synthesizing the condensed meaning into descriptions and
146 concepts (See Appendix 2 for examples). STC was chosen as the procedure facilitates cross-
147 case synthesis of text and meaning [28]. Consequently, in the first step, the interview

1
2
3 148 transcripts were read to get a general impression of the whole and to identify primary
4
5 149 themes. Then, meaning units were identified and formulated into codes that represented
6
7
8 150 the core of the statements. During this phase, three of the authors (JE, AC, and CSH) worked
9
10 151 individually to identify as many perspectives and perceptions as possible in the material.
11
12
13 152 Next, all authors worked together with the coded data to produce one set of data, extracting
14
15 153 duplicates and data that were not relevant for the aim of the study. The coded data were
16
17 154 then organized into subcategories, and the content of the meaning units of each category
18
19 155 was re-examined. The meaning and representation of the data was formulated into aspects
20
21 156 representing the content. Thereafter, the subcategories were organized into categories. To
22
23 157 validate the categories and make sure that no important aspects had been overlooked, the
24
25 158 clusters were referred back to the raw data, and read through once again by the authors.
26
27 159 Finally, the re-contextualized data was expressed as interpretations of the meaning of each
28
29 160 category and representative quotes were selected for each category/subcategory.
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39 162 **RESULT**

40 163 Three main categories were uncovered during the analysis:

- 41
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43 164 1) Management options for mitigating the consequences of OA,
44
45 165 2) Experiences of the digital program, with four sub-categories a) Easy to execute, b)
46
47 166 Flexibility to choose when and where, c) The importance of interacting with healthcare
48
49 167 professionals and d) Other motivating factors and 3) Perceived effects of the digital program
50
51 168 over time, with two subcategories a) Perceived effects of the program after the initial six
52
53 169 weeks and b) Reasons for continuing to participate in the program (Figure 1). Participants'
54
55 170 suggestions for improving the digital program were also analyzed.
56
57
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60 171

172 **Management options for mitigating the consequences of OA**

173 This category entailed the experiences of the perceived consequences of OA and their eager
174 search for a cure that would reduce their symptoms. All participants described symptoms
175 such as pain, disrupted sleep, deteriorating ability to walk, being immobile, and activity
176 limitations. Pain was the main motivation for seeking professional management. The
177 participants also found that their decreased functioning was not only affecting themselves,
178 but was also a burden on their partners and family. They were trying all sorts of ways to ease
179 the pain and to regain motor function. They were eager to try any treatment hoping that the
180 program could reduce their symptoms and improve their quality of life.

181

182 *"I felt that it was impossible to continue in this way as I was in such intense pain..."*

183 (I18)

184

185 *"The expectations that I had were to be more flexible and to reduce the pain.*

186 *That was how I figured it could be."* (I18)

187

188 **Experiences of the digital program**

189 This category includes four sub-categories; a) Easy to execute, b) Flexibility to choose when
190 and where, c) The importance of interacting with healthcare professionals and d) Other
191 motivating factors. In general, the participants' experiences of the program were positive.
192 They found the program very easy to execute, flexible, and motivational. The interaction
193 with the physical therapist was described as important for support and encouragement.

194

1
2
3 195 **Easy to execute**

4 196 Most participants were satisfied with the set-up of the program. The program was perceived
5
6
7 197 as structured, educational, and very simple to execute. Other elements that facilitated
8
9 198 participation were instructional videos, email reminders, and that the exercises were
10
11 199 individually customized with increasing difficulty, but also quickly accomplished.

12
13
14 200

15 201 *"This is such a great set-up. Not only the exercises, it's really educational and you*
16
17
18 202 *learn what osteoarthritis is really about."* (I13)

19
20 203

21
22
23 204 *"I found it really easy to follow. It does not take long and it's really good to*
24
25 205 *receive these reminders by email"* (I18)

26
27 206

28
29 207 However, a few participants perceived some difficulties in understanding how the program
30
31
32 208 worked. They found that the progression of the exercises was not clearly described or that it
33
34 209 was difficult to understand specific words used in the videos.

35
36
37 210

38
39 211 *"To me it was hard to follow in the beginning and it actually took some time*
40
41
42 212 *before I understood it correctly. It took like a few weeks until I really got the*
43
44 213 *system. And that was a pity I think."* (I8)

45
46
47 214

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49
50 215 **Flexibility to choose when and where**

51 216 All participants acknowledged the flexibility that was associated with this digital
52
53
54 217 management program. The ability to execute the exercises at home, or at any place at any
55
56 218 time, without any use of equipment was highly appreciated. The ability to control the time
57
58 219 point for when to perform the exercises and not having to make a scheduled appointment at
59
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1
2
3 220 a specific location, were described as an advantage compared to traditional management,
4
5
6 221 and were further expressed as time-saving and less stressful since participants did not have
7
8 222 to take time off from work for OA management. One participant even expressed that she
9
10 223 would never have completed such a program if it had not been digital.

11 224

12
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14
15 225 *“The flexibility, that I could decide on my own when to perform the exercises was*
16
17 226 *really good. That I didn’t have any scheduled time point when I had to dress, go*
18
19 227 *out, and at this exact time point meet a physical therapist. That I could decide on*
20
21 228 *my own...” (I11)*

22 229

23
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26
27 230 *“I don’t think this is bad at all, to have it on the internet like this. I would never*
28
29 231 *have done it if it hadn’t been digital” (I17)*

30 232

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34
35 233 Some participants described that there were long waiting lists for traditional OA
36
37 234 management in primary care and that the digital program was, thus, a flexible alternative
38
39 235 that they could start at once.

40 236

41
42
43 237 *“Yes, it was also like, there was such a long waiting list for primary care. So I*
44
45 238 *thought...this...this I can start doing right away.” (I10)*

46 239

47 240 *The importance of interacting with healthcare professionals*

48
49
50
51 241 Receiving an OA diagnosis without any physical meeting was perceived as a bit awkward to
52
53 242 some participants. Some concerns were revealed regarding the risk of missing serious
54
55 243 diseases if the diagnosis was given by phone or internet.

56 244

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2
3 245 *"It's somewhat hard to give a diagnosis over the phone. You can do it, but it's*
4
5 246 *more difficult and you can miss things... there could have been a tumor there..."*

7
8 247 (I14)

9
10 248
11
12 249 The majority of the participants had a very positive experience of the interaction with their
13
14
15 250 online physical therapist. They described that they received fast responses to their
16
17 251 questions, as well as information and encouragement, and that they often received feedback
18
19 252 within a few hours. Some expressed that the engagement from their physical therapist was
20
21 253 valuable for support and encouragement, especially if they experienced pain during the
22
23 254 exercises. The daily contact with their physical therapist encouraged them to perform their
24
25 255 exercises every day, which was also perceived as an advantage compared to traditional care
26
27 256 management.
28
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30

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32 257
33
34 258 *"I think it's excellent to have daily contact. I think it's outstanding. That puts*
35
36 259 *pressure on me to really do these exercises and to answer him [the physical*
37
38 260 *therapist] and to give him an opportunity to give feedback and information about*
39
40 261 *other things... You can't go to a physical therapist every day, every day, every*
41
42 262 *day. That won't work. They won't have time for me, they have others to take care*
43
44 263 *of as well. "* (I12)

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46 264
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50
51 265 In contrast, some participants experienced the contact with their online physical therapist to
52
53 266 be unsatisfactory or even non-existent. They described that it could take a week before they
54
55 267 received any response, that the questions were only partly answered, or that they received
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3 268 no answer at all. Continuous follow-up with feedback and encouragement on their
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6 269 performance in the program was also lacking.
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8 270
9
10 271 *"In the beginning they said that someone would get in touch with me on a*
11
12
13 272 *regular basis and things like that. But this hasn't happened as I expected"* (19)
14

15 273
16
17 274 **Other motivating factors**
18
19 275 The daily email reminders were typically highlighted as a motivator since they ensured that
20
21 276 participants did not forget about the exercises and pushed them to perform the activities
22
23 277 every day. Improved OA symptoms, and the measurement feedback system provided by the
24
25
26 278 program were other factors that were mentioned as contributing to the participants'
27
28 279 motivation to perform the exercises.
29

30
31 280
32 281 *"It was there, popped up in my email box every day. OK, today I'll do this*
33
34 282 *exercise...it was something that pushed me. That was good I think...I needed*
35
36 283 *that."* (18)
37
38

39 284
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43 285 **Perceived effects of the digital program over time**
44 286 This category includes two sub-categories; a) Perceived effects of the program after
45
46 287 the initial six weeks and b) Reasons for continuing to participate in the program. The
47
48
49 288 majority of the participants reported improved functioning and reduced pain.
50
51 289 However, some people felt no improvements and that their symptoms were the same
52
53
54 290 as before entering the program. Many continued to participate in the program after
55
56 291 the initial six weeks to maintain the positive improvements. Although the participants
57
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59
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1
2
3 292 were positive to the digital program, they suggested a broader variation of exercises
4
5
6 293 as well as follow-ups by video calls.
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8 294
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10
11 295 *Perceived effects of the digital program after the initial six weeks*

12 296 Several participants experienced significant reductions in OA symptoms after completing the
13
14
15 297 program. Improvements commonly mentioned were reduced pain, increased flexibility, and
16
17 298 improved walking abilities. In many cases the symptoms were still present but were
18
19
20 299 perceived to have improved significantly, leading to increased quality of life and less focus
21
22 300 on the disease. Many described that they had recommended the program to friends and
23
24 301 relatives suffering from hip or knee OA, since they were satisfied with the result and wished
25
26
27 302 that more people could undergo the same management program.
28

29 303
30

31
32 304 *“It has helped me fantastically. I don’t think I could have walked the way I do*
33
34 305 *today if I hadn’t done this... I don’t think so... I think this program has had an*
35
36 306 *absolute crucial role in the fact that I can manage my everyday life as well as I*
37
38 307 *can now, even though I have quite big problems.” (I2)*
39
40

41 308
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45 310 Not all participants perceived that they had reduced symptoms or improvements after six
46
47
48 311 weeks in the program. Some described that their symptoms were still the same or had
49
50 312 initially improved, and then worsened with deteriorating physical function and increased
51
52
53 313 pain. However, several of these participants still believed in the set-up despite not
54
55 314 experiencing the results they wished for. This lack of positive results was attributed to a
56
57
58 315 belief that they entered the program too late, i.e., that the exercises might have helped if
59
60

1
2
3 316 they had started at an earlier stage of the disease, or that the exercises may have slowed
4
5
6 317 down the disease progression.
7

8 318
9
10 319 *“The sad thing is that even if I do these exercises, every day, every week, every*
11
12
13 320 *month, every year... nothing happens... I don’t get any better.” (14)*
14

15 321
16
17 322 *“It felt really good in the beginning. The reason that it didn’t help me is probably*
18
19
20 323 *because I started too late.” (112)*
21

22 324

23 325

24 326 *Reasons for continuing to participate in the program*

25 327

26 328 Many continued to do their exercises after the six weeks evaluation. Perceived functional
27
28
29
30 329 improvements and pain reduction as well as fear of the symptoms worsening were highly
31
32
33 330 motivating factors for continuing to perform the exercises. Another reason was that it might
34
35 331 help them to be well prepared for any upcoming surgery.
36

37 332

38
39 333 *“I believe in these exercises. I believe that exercise is good for osteoarthritis. I am*
40
41
42 334 *convinced. And I think... if I stop doing this... then this terrible pain will start*
43
44
45 335 *again.” (18)*
46

47 336

48
49 337 On the other hand, reduced pain and scheduled surgery were described by some
50
51
52 338 participants as reasons for not continuing the program.
53

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55 339
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3 340 *"The pain was generally reduced... and then I did not feel as motivated as before*
4
5
6 341 *so I quit doing the exercises... yes I did. Generally, in physical therapy, it's hard to*
7
8 342 *keep your motivation up if you don't have a lot of pain."* (I19)
9

10 343
11
12 344 *"I have met with my orthopedist and I'm scheduled for surgery... I feel that the*
13
14
15 345 *end of this problem is near. That's why I'm not performing the exercises as I*
16
17 346 *should anymore."* (I18)
18
19

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21 347

22 348 **Suggestions for improving the digital program**

23 349 The participants suggested a few possible improvements to the digital program. For
24
25
26 350 example, many experienced that there were too few exercises with little variation, and the
27
28
29 351 exercises were perceived as somewhat monotonous after a while, especially if the
30
31
32 352 participants were highly active in the program, i.e., carried out exercises several days a
33
34 353 week. It was suggested that varying and/or adding more exercises would increase
35
36 354 motivation to perform them.
37
38

39 355 *"In the end it became a bit boring since there were so few movements... so I*
40
41
42 356 *added some extra on my own... It was a bit boring to do the same thing every*
43
44 357 *day."* (I14)
45
46

47 358

48
49 359 Some participants that were not satisfied with the communication with the
50
51
52 360 online physical therapist suggested improved patient-physical therapist
53
54 361 interaction using increased feedback and encouragement. Another suggestion
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56 362 included follow-ups video calls or Skype to enhance feedback on the individual
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59 363 performance of specific exercises
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“You could send a video via internet and the physical therapist will then check that you have performed the exercise and performed it correctly and correct you if you have performed it incorrectly.” (I19)

369 DISCUSSION

370 We sought to investigate participant experiences of a digital management program for hip
371 and knee OA. The majority of the participants reported improvements after the initial six
372 weeks, such as reduced pain, increased mobility, and a sense of improved quality of life. In
373 general the participants found that the program was easy to execute. The flexibility of being
374 able to perform the exercises anywhere and at any time point was highly appreciated. The
375 daily contact with the physical therapist was considered very important and an advantage
376 compared to traditional care and the participants felt that the support and encouragement
377 they received was important to continue exercising. In addition, the participants suggested
378 more variation in the exercises and follow-up by video-calls.

379
380 Despite international guidelines [12], many patients with hip and knee OA do not receive
381 appropriate treatment and information regarding OA management options [4, 13, 14]. Web-
382 based or digital management programs have been proposed as an option for facilitating the
383 implementation of non-surgical treatment as they have the potential to reach more
384 individuals in need of OA treatment [4]. The participants in the current study were mostly
385 positive to the set-up of the program. Being able to perform the exercises whenever and
386 wherever they desired, without needing to take time off from work, was described as
387 valuable. Several participants also mentioned that the digital program was something they

1
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3 388 could start doing right away instead of being put on a waiting list. They also experienced the
4
5 389 program to be educational and they felt motivated by the daily email reminders and the
6
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8 390 feedback system that were provided by the program. This result is in line with previous
9
10 391 studies investigating patient perceptions of digital OA management, e.g., through internet or
11
12 392 tele rehabilitation, where the participants experienced such programs to be convenient and
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15 393 time-saving [30, 31].
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21 395 Exercise is one of the cornerstones of OA management [12]. However, the outcome of the
22
23 396 OA management program is highly dependent on adherence to the exercises. People with
24
25 397 OA is reported to be among those with particularly poor adherence to this type of treatment
26
27 398 [32], although there seem to be good adherence to treatment delivered online in these
28
29
30 399 patients [33]. A recent systematic review of people with hip and knee OA identified factors
31
32 400 such as increased knowledge of the disease and benefits of exercise, reduced symptoms,
33
34 401 easy access to training facilities, and the ability to fit the exercises into daily life as facilitating
35
36 402 exercise participation, whereas long travel time and parking difficulties were considered as
37
38 403 barriers [34]. The results from the current study indicate that a digital program may facilitate
39
40 404 participation in OA management programs and eliminate some of the barriers associated
41
42 405 with exercise participation, such as access and time constraints, and further highlights the
43
44 406 importance of adequate information and education regarding the benefits of exercise and
45
46 407 different treatment options in OA. In addition, a digital delivery also enables the patients to
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48 408 continue their treatment week after week to further improvements and to sustain their
49
50 409 achieved behavioral change.
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3 411 Previous research indicates that support and encouragement from healthcare staff are
4
5 412 important factors in facilitating exercise participation in people with hip and knee OA [34].
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8 413 This was also reflected in the current study. Interaction with the physical therapist was
9
10 414 another important aspect that was highlighted by the participants. Most participants had a
11
12
13 415 positive experience of the contact with their assigned physical therapist and they were
14
15 416 highly motivated by the daily contact and the support and encouragement that were
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17
18 417 provided. This result further emphasizes previous findings that a strong therapeutic alliance
19
20 418 can be established without meeting in person [35-37]. However, some participants were not
21
22
23 419 satisfied with the contact, which in turn lowered their motivation to perform the exercises.
24
25 420 This may indicate that support and encouragement from the physical therapist are
26
27 421 prerequisites for a satisfactory experience of a digital OA management program.
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30 422
31
32 423 In accordance with studies on tele rehabilitation, [30, 31], some concerns were expressed in
33
34
35 424 our interviews about being diagnosed online. A few patients were afraid that they may have
36
37 425 been suffering from a more serious disease, such as cancer, and that a differential diagnosis
38
39
40 426 may be difficult via the internet. It is therefore important to respond to these worries
41
42 427 accordingly, and provide the patients with information that explains that OA is primarily
43
44
45 428 diagnosed by symptoms and signs without any use of radiography or laboratory equipment
46
47 429 [38]. Also, some participants wished to have follow-ups via video call to eliminate the risk of
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50 430 performing the exercises incorrectly. This is consistent with previous studies reporting that
51
52 431 non-supervised home-based exercises can give rise to concerns regarding the correct
53
54 432 performance of the exercises [5, 31, 39]. Video calls may, thus, be one way to develop the
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57 433 program further and to optimize the experiences of digital programs without any physical
58
59 434 meeting. However, the influence of video conversations needs further study.
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6 436 The results confirmed the findings of previous studies, in that the participants reported that
7
8 437 the most important results of the program were improvements such as reduced pain,
9
10 438 increased flexibility, and improved walking abilities [18, 19], which brought a sense of
11
12
13 439 improved quality of life and less focus on the disease. Interestingly, reduced pain and being
14
15 440 scheduled for surgery were two factors described as both facilitators and barriers to
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17
18 441 continuing in the program. Some participants continued to exercise because they
19
20 442 experienced that the program had reduced their pain and they were afraid that the pain
21
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23 443 would come back if they stopped doing the exercises. In contrast, some felt that reduced
24
25 444 pain was a reason to stop doing the exercises, as their motivation was lost when pain no
26
27
28 445 longer was an issue. Likewise, some participants continued to exercise since they wanted to
29
30 446 be ready and as fit as possible for a total joint replacement (TJR), whereas others quit doing
31
32
33 447 the exercises when they were scheduled for TJR as they believed the surgery would solve
34
35 448 their problems anyway. Pre-surgery exercise is known to improve outcomes such as length
36
37
38 449 of hospitalization, knee range of motion, and physical function after total knee replacements
39
40 450 [40] and such information is, therefore, important to include in the educational material to
41
42 451 facilitate recovery after any future TJRs in these patients.
43
44

45 452
46
47 453 One strength of this study is that the participants were purposefully selected, including both
48
49 454 men and women who differed in age, OA severity, physical function, and OA location (hip or
50
51
52 455 knee) from different parts of Sweden. However, since the participants were located all over
53
54 456 Sweden, the interviews were mostly conducted by telephone or via Skype. This approach
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56
57 457 may have resulted in less depth of the interviews due to a loss of visual input. Also, two of
58
59 458 the participants completed the program more than one year prior to the interviews, which
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3 459 may have influenced their recollection of the program and thereby also the experiences
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6 460 expressed during the interviews. Another limitation may be that some demographic data of
7
8 461 the participants, such as education level, previous experience of using digital applications
9
10 462 and year of OA diagnosis were not recorded. This information may have increased the
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12
13 463 generalizability of the results.
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18 465 Throughout the data analysis reflexivity has been considered, i.e., we have been aware that
19
20 466 the pre-understanding that the authors may have as clinicians and researchers could affect
21
22 467 the data, if one is not fully aware of previous experiences [41]. All authors worked separately
23
24 468 during the data processing and there were continuous discussions during the analysis aimed
25
26 469 at eliminating possible influences of previous experiences, which helped us to stay neutral to
27
28 470 the data. In addition, we have also presented a signature after each quotation to show the
29
30 471 representation of our participants, and to add transparency and trustworthiness to our
31
32 472 findings and interpretations of the data.
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38 473 **CONCLUSION**

39 474 A digital management program for OA, including education and exercise as well as
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41 475 asynchronous chats with an assigned physical therapist for feedback, questions and
42
43 476 engagement, may be an alternative to traditional treatment and further facilitate the
44
45 477 implementation of OA guidelines in a wider community. The participants had mostly positive
46
47 478 experiences of the program, the flexibility of the program with regards to location and time.
48
49 479 Regular and frequent contact with a physical therapist was deemed particularly important
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51 480 for a positive experience of the program and was also emphasized as an advantage
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53 481 compared to traditional care. In addition, the result of this study will contribute to the
54
55 482 further development and improvement of digital management for OA.
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5 484 **AUTHORS' CONTRIBUTION**
6
7 485 Anna Cronström, PhD contributed to the design of the study, conducted part of the
8
9 486 interviews, was responsible for the analysis and interpretation of the data, and was in charge
10
11 487 of writing the manuscript. Leif E Dahlberg, PhD contributed to the conception and design of
12
13 488 the study, contributed to the interpretation of the data, and provided feedback on drafts of
14
15 489 this paper. Håkan Nero, PhD contributed to the conception and design of the study,
16
17 490 contributed to the analysis and interpretation of the data, and provided feedback on drafts
18
19 491 of this paper. Jennifer Ericson, BSc student contributed to the conception and design of the
20
21 492 study, conducted part of the interviews, contributed to the analysis and interpretation of the
22
23 493 data, and provided feedback on drafts of this paper. Catharina Sjö Dahl Hammarlund, PhD
24
25 494 contributed to the conception and design of the study, contributed to the analysis and
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27 495 interpretation of the data, and provided feedback on drafts of this paper. All authors have
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51 503 **COMPETING INTEREST**
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53 504 HN is a physical therapist and part-time consultant at Joint Academy and LED is the co-
54
55 505 founder and Chief Medical Officer in the corporation behind the same program. No other
56
57 506 relationships or activities exist that could appear to have influenced the submitted work.
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3 508 **DATA SHARING STATEMENT**
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5 509 The datasets used and/or analyzed during the current study are available from the
6
7 510 corresponding author on reasonable request.
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665 **Table 1.** Characteristics of the participants

666	Characteristics	n=19
667	Age mean (min-max)	65 (45-80)
668	Sex	
668	Women n	10
669	Men n	9
670	Retired n	10
670	OA location	
671	Hip n	10
671	Knee n	9
672	Pain baseline (min-max)	6.1 (1-9)
672	Physical function baseline (min-max)	8.6 (1-14)
673	EQ5D-3L index baseline (min-max)	0.59 (0.29-0.76)
674	Activity in the program mean % (min-max)	80.7 (19-93)

675 OA=osteoarthritis, pain was assessed with the Numeric Rating Scale (NRS) from 0-10, where
 676 0 indicate no pain with higher numbers indicating more severe pain, physical function was
 677 assessed using the 30-second Chair Stand Test reflecting the number of repetitions of sitting
 678 to standing from a chair during a period of 30 seconds. EQ5D-3L= EuroQol – 5 dimension
 679 descriptive system assessing health-related quality of life - a higher EQ-5D-3L index indicates
 680 better health-related quality of life. Activity level was defined as the proportion of
 681 completed videos, exercises and questionnaires offered in the program.

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683 **Figure 1.** Overview of the categories and subcategories describing the participants' experiences of
684 the digital
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For peer review only

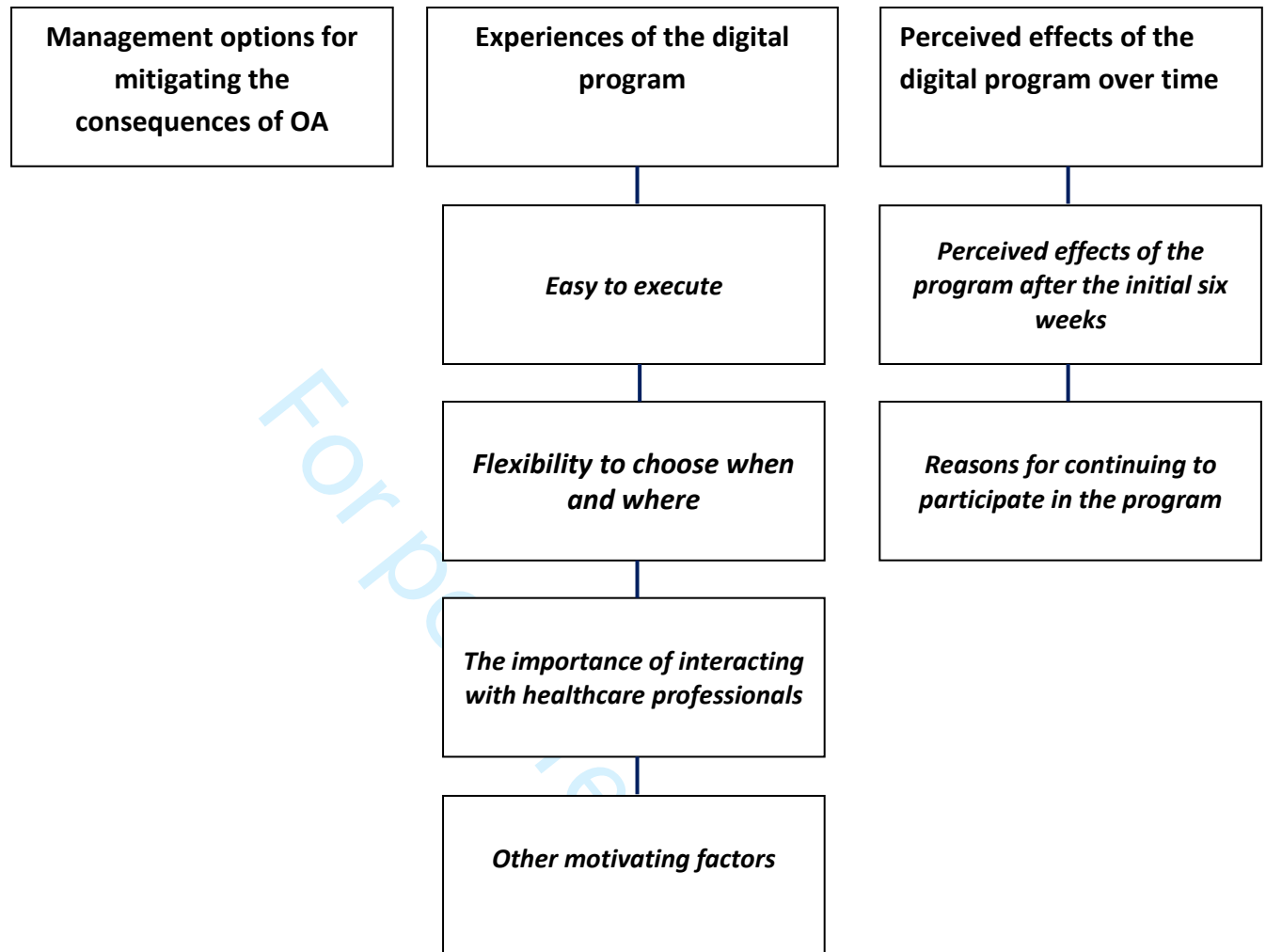


Figure 1. Overview of the categories and subcategories describing the participants' experiences of the digital management program for osteoarthritis

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3 **Appendix 1. Interview guide - Experiences of a digital management program for hip and**
4 **knee osteoarthritis** (translated from the Swedish version)
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8 How long have you had symptoms from your hip/knee?
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10 Could you describe your symptoms before joining the program?
11

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- 13 • How did your symptoms affect you everyday life?

14 What were your reasons for joining the program?
15

16 What were your expectations before joining the program?
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18 How did you experience the treatment?
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- 20
- 21 • Set-up
 - 22 • Exercises
 - 23 • Availability
 - 24 • Layout
- 25

26 How was your motivation for doing the activities?
27

28 How did you experience your contact with the physical therapist?
29

30 Do you experience that the treatment has altered your symptoms?
31

- 32
- 33 • In what way/direction?

34 Have you continued with the program/home exercises after the initial six weeks?
35

- 36
- 37 • What were your reasons/motivations for continue/not continue?
- 38

39 How do you think Joint Academy could have done a better job in assisting your treatment?
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44 At the end of the interview asking the participant to raise any subject not yet covered
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46 Throughout the interview the participants were asked to elaborate on the subject and to
47 explain or clarify the meaning and consequences of their experiences
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Appendix 2**Table 1.** Examples of themes, meaning units, condensation of meaning units, codes and descriptions and concepts.

Interview and page	Themes	Meaning units	Condensed meaning unit	Code	Descriptions and concepts
2B3	Motivation	I wanted to continue because I know it's good for me. And I know deep inside that exercises will help me.	I know it will help me	Motivated by improvements	Other motivating factors
3c9	Flexibility	I had access 24/7. I could do it when it fitted me.	When it fitted me	Could do the exercises when it fitted the participant	Flexibility to choose when and where
10J4	Change in OA symptom	Yes, the pain was reduced and almost disappeared some days. I really improved so it was all positive	Reduced pain	The program reduced the OA symptoms	Perceived effects of the digital program over time

COREQ (CONsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			NA
<i>Personal characteristics</i>			
Interviewer/facilitator	1	JE & AC	7 & 22
Credentials	2	JE: BSc student, AC: PhD	22
Occupation	3	JE: Physiotherapy student, AC: Researcher	22
Gender	4	JE & AC: Female	
Experience and training	5	Basic training	7
<i>Relationship with participants</i>			
Relationship established	6	No relationship	NA
Participant knowledge of the interviewer	7	All participants had oral and written information which included that the data collection was part of her Bachelor thesis and future scientific publications.	6-7
Interviewer characteristics	8	JE & AC showed interest and empathy and gave relevant follow-up questions to encourage the participants to elaborate on their narratives.	
Domain 2: Study design			
<i>Theoretical framework</i>			
Methodological orientation and Theory	9	Systematic text condensation as described by Malterud, which is based on Giorgis' psychological phenomenological analysis (ref 21,22)	8
<i>Participant selection</i>			
Sampling	10	The participants were purposefully selecteddifferent age groups, perceived pain and physical function They were consecutively included...	6-7
Method of approach	11	Seventy three invitations with written information about the study were sent out by e-mail. Twenty-one accepted the invitation.	6
Sample size	12	Nineteen participated...	7
Non-participation	13	Two were excluded. One did not speak Swedish, one could not be reached.	7
<i>Setting</i>			
Setting of data collection	14	Mostly in their homes using Skype or telephone, two personal interviews	7
Presence of non-participants	15	None else were present besides the participants and researchers.	NA
Description of sample	16	Ten women and nine men, median age 66 (q1-q3, 57-71) years, OA joint location was either in the knee (48%) or hip (52%).	7
<i>Data collection</i>			
Interview guide	17	The interview guide and follow-up questions were pilot tested and were then subjected to minor editing.	7
Repeat interviews	18	No repeat interviews were carried out	NA
Audio/visual recording	19	The interviews were recorded.	8
Field notes	20	Field notes was taken with regard to emotinal reactions and so on.	
Duration	21	The duration was approximately 30-40 minutes.	8
Data saturation	22	Data collection stopped when no further information was added.	8
Transcripts returned	23	The transcripts were not returned to participants for comment and/or	NA

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction.	
Domain 3: analysis and findings			
<i>Data analysis</i>			
Number of data coders	24	Three authors coded the data (JE,AC,CSH)	8
Description of the coding tree	25	The coding tree was not provided.	NA
Derivation of themes	26	The themes derived from the data.	8
Software	27	No software was used to manage the data.	NA
Participant checking	28	The participants did not provide feedback on the findings.	NA
<i>Reporting</i>			
Quotations presented	29	Participant quotations was presented to illustrate the findings and each quotation was identified with a signature.	21
Data and findings consistent	30	The data was rich, varied and consistent. No triangulation was done.	21
Clarity of major themes	31	Major themes were clearly presented in the findings.	8-17
Clarity of minor themes	32	There is a description of diverse cases and discussion of minor themes.	18-21

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.

BMJ Open

I would never have done it if it hadn't been digital": A qualitative study on patients' experiences of a digital management program for hip and knee osteoarthritis in Sweden

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-028388.R2
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Date Submitted by the Author:	18-Apr-2019
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Primary Subject Heading:	Rehabilitation medicine
Secondary Subject Heading:	Rehabilitation medicine
Keywords:	osteoarthritis, e-health, non-surgical management

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3 1 **Original research article**
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7 3 **“I would never have done it if it hadn’t been digital”: A qualitative study on**
8 **patients’ experiences of a digital management program for hip and knee**
9 **osteoarthritis in Sweden**
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13 6 Anna Cronström¹, Leif E Dahlberg^{1, 2}, Håkan Nero¹, Jennifer Ericson³, Catharina Sjö Dahl
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40 18 **Keywords:** e-health; digital management; osteoarthritis
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19 ABSTRACT

20 Objectives

21 To investigate the experiences of a digital management program for hip and knee
22 osteoarthritis (OA), including education and exercises as well as an option to chat with an
23 assigned physical therapist for feedback, questions and support.

24 Setting

25 This study was conducted at a regional hospital in the southern part of Sweden.

27 Methods

28 Nineteen patients (10 women), median age 66 (q1-q3, 57-71) years, with confirmed hip or
29 knee OA were interviewed after completing their first six weeks in the program, using a
30 semi-structured interview guide. The interviews were transcribed verbatim and were
31 qualitatively analyzed using systematic text condensation.

33 Results

34 Three categories emerged during the interviews:

35 1) *Management options for mitigating the consequences of OA*; 2) *Experiences of the digital*
36 *program* and 3) *Perceived effects of the digital program over time*. The participants had
37 mostly positive experiences of the program. Particularly important for these experiences
38 were no waiting list, the flexibility of taking part in the program with regards to location and
39 time, and the possibility to have daily contact with a physical therapist. These aspects were
40 also emphasized as advantages compared to traditional care.

41

42 Conclusions

43 Digital management of OA, including education and exercise, was experienced as a valid
44 alternative to traditional treatment in enabling the implementation of OA guidelines in a
45 wider community. Easy access, exercising at one's own convenience, flexible options, daily
46 follow-up and support by a physical therapist were mentioned as the most important
47 features. In addition, the results will contribute to further development and improvement of
48 digital OA management programs.

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Strengths and limitations of this study

- Participants were purposefully selected, including both sexes, who differed in age, osteoarthritis severity and physical function in order to have rich and varied data, when synthesizing shared patterns across cases
- The use of a systematic text condensation analysis method facilitated cross-case synthesis of text and meaning
- Conducting the interviews via telephone may have resulted in less depth of the interviews due to a loss of visual input, but also allowed inclusion of participants from a wide geographic area.

53 BACKGROUND

54 Due to a combination of decreasing healthcare resources, long waiting lists, and difficulty to
55 meet the demands of the modern individual who often has a busy schedule, the use of web-
56 based or digital management options in healthcare, has increased significantly during the
57 last decade [1-3]. Accessibility and flexibility, social motives and an option for anonymity and
58 confidentiality are common arguments for choosing digital options [4-10]. A recent review
59 also suggests that it may be easier to seek care and to incorporate the training into daily life
60 when it is accompanied by the flexibility and anonymity that online delivery provides, and
61 that some people even rated their relationship with the online-therapist higher than their
62 relationship with their ordinary therapist [6]. However, web-based or digital management
63 for musculoskeletal disorders have thus far not been studied to any great extent [11].

64
65 Individuals with osteoarthritis (OA) constitute one group of patients for whom digital
66 management may be highly beneficial [4, 11]. As concluded previously in various literature,
67 the guidelines for OA treatment (education, exercise and weight management)[12] are not
68 always implemented and few individuals with OA receive adequate management [4, 13, 14].
69 Lack of healthcare resources, living in rural areas, and having a lower level of education are
70 all factors that may reduce the likelihood of receiving appropriate information on
71 management options for OA [4, 14]. Web-based or digital interventions for OA have been
72 suggested as a way to make the availability of guideline-based OA management accessible to
73 a wider community [4, 11, 15]. Unlike in patients with inflammatory arthritis where digital
74 management does not seem to increase physical activity or quality of life [16], a few studies

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3 75 have shown promising results of digital interventions on physical activity [17], pain and
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6 76 physical function in patients with hip or knee OA [11, 15, 18-20].
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12 78 Joint Academy [19, 21, 22], was developed in Sweden and is a digital version of the evidence-
13
14 79 based face-to-face self-management program *Better Management of Patients with*
15
16 80 *OsteoArthritis* (BOA) [13, 23]. The program, as thoroughly described previously [19],
17
18 81 comprises OA education (instructional videos on OA, physical activity and weight
19
20 82 management), individualized neuromuscular exercises with increasing difficulty aiming at
21
22 83 improving lower extremity strength and neuromuscular control, and an option to chat
23
24 84 asynchronously with an assigned physical therapist for feedback and questions. Studies have
25
26 85 shown that completing the introduction phase of six weeks in this digital OA management
27
28 86 program reduces pain and medication intake, increases physical function and walking ability,
29
30 87 as well as reduces the willingness for surgery [18, 19, 24]. However, patient experience of
31
32 88 digital management for OA has not yet been evaluated. This knowledge may help to further
33
34 89 improve digital management options for OA and to facilitate the implementation of OA
35
36 90 guidelines in a wider community. Thus, the aim of this qualitative study was to investigate
37
38 91 the patients' experiences of using a digital management program for hip and knee OA.
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50 93 **METHOD**

51 94 **Patient and public involvement statement**

52 95 The Joint Academy treatment program for OA is based on the evidence-based BOA concept
53
54 96 [13]. In addition to the interviews in the present study, the digital platform has previously
55
56 97 been further developed and improved by analyzing questionnaires and opinions from
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1
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3 98 patients recruited via the Swedish Rheumatism Association. These patients were able to test
4
5 99 Joint Academy and were extensively interviewed about their opinions. All other aspects of
6
7
8 100 this research were performed without patient involvement. Patients were not invited to
9
10 101 comment on the study design and were not consulted to develop patient-relevant outcomes
11
12
13 102 or interpret the results. Patients were not invited to contribute to the writing or editing of
14
15 103 this document for readability or accuracy.
16
17
18 104

19 20 105 **Setting and sampling**

21 106 This study was conducted at a regional hospital in the southern part of Sweden. From a total
22
23
24 107 sample of 462 individuals that had completed six weeks in the digital OA management
25
26 108 program between 2015 and 2018, 73 invitations with written information about the study
27
28
29 109 were sent out by e-mail by the first author (AC). The inclusion criterion was clinical hip or
30
31 110 knee OA, previously confirmed or diagnosed according to the ACR criteria [25, 26] by an
32
33
34 111 orthopedic surgeon involved in the program. The exclusion criteria were i) reporting other
35
36 112 joints than hip or knee as the primary joint for OA symptoms, and ii) not understanding
37
38
39 113 and/or speaking Swedish. The participants were purposefully selected in order to represent
40
41 114 both sexes, different age groups, perceived pain and physical function [27]. Twenty-one
42
43
44 115 participants accepted the invitation to participate in this study. Two were excluded as one
45
46 116 did not speak Swedish and one did not return our phone calls. Ten women and nine men,
47
48
49 117 median age 66 (q1-q3, 57-71) years were consecutively included in the study. Their primary
50
51 118 OA joint location was either in the knee (48%) or hip (52%) (See Table 1 for participant
52
53
54 119 characteristics). All participants in this study completed the program via stationary
55
56 120 computers, laptops or mobile phones. The Regional Ethical Review Board in Lund, Sweden
57
58
59
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2
3 121 (Dnr 2017/651; Dnr 2017/980) approved the study and all patients gave their written
4
5 122 informed consent prior to participation.
6
7
8 123

11 124 **Data collection**

12 125 The interviews were conducted by two of the authors (JE, physical therapy student & AC,
13
14
15 126 physical therapist and PhD), either as face-to-face interviews, by Skype or by telephone,
16
17
18 127 depending on the participant's location and access to Skype. The semi-structured interview
19
20 128 guide included areas of interest such as 1) experiences of living with OA, 2) prior experiences
21
22
23 129 of OA management, 3) experiences of the digital management program (e.g., set-up,
24
25 130 educational contents, feed-back, feed-forward, availability and design), and 4) experiences
26
27
28 131 of factors that may have increased their motivation, persistence and emotional reactions. In
29
30 132 addition, the participants were asked to suggest possible improvements to the program.
31
32
33 133 Follow-up questions were used to encourage the participants to elaborate on the subject
34
35 134 and to explain or clarify the meaning and consequences of their experiences. The interview
36
37
38 135 guide and follow-up questions were pilot tested on three older individuals with OA, not
39
40 136 included in the study and was then subjected to minor editing. The two interviewers
41
42
43 137 completed basic training in interview technique prior to data collection and had no relation
44
45 138 to the participants in this study. The interviews, which lasted approximately 30-40 minutes,
46
47
48 139 were recorded and transcribed verbatim. Data collection stopped when no further
49
50 140 information was added, i.e., the interviews did not add any new information to the results.
51
52 141 See Appendix 1 for interview guide.
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54
55 142

143 **Data analysis**

144 The transcripts were analyzed using systematic text condensation (STC) according to
145 Malterud [28], which is based on Giorgi's phenomenological analysis [29]. The procedure of
146 the analysis consists of the following steps: 1) creating an overall impression and identifying
147 themes; 2) distinguishing and sorting meaning units to codes; 3) formulating the meaning of
148 each code meaning and 4) synthesizing the condensed meaning into descriptions and
149 concepts (See Appendix 2 for examples). STC was chosen as the procedure facilitates cross-
150 case synthesis of text and meaning [28]. Consequently, in the first step, the interview
151 transcripts were read to get a general impression of the whole and to identify primary
152 themes. Then, meaning units were identified and formulated into codes that represented
153 the core of the statements. During this phase, three of the authors (JE, AC, and CSH) worked
154 individually to identify as many perspectives and perceptions as possible in the material.
155 Next, all authors worked together with the coded data to produce one set of data, extracting
156 duplicates and data that were not relevant for the aim of the study. The coded data were
157 then organized into subcategories, and the content of the meaning units of each category
158 was re-examined. The meaning and representation of the data was formulated into aspects
159 representing the content. Thereafter, the subcategories were organized into categories. To
160 validate the categories and make sure that no important aspects had been overlooked, the
161 clusters were referred back to the raw data, and read through once again by the authors.
162 Finally, the re-contextualized data was expressed as interpretations of the meaning of each
163 category and representative quotes were selected for each category/subcategory.

164

165 RESULT

166 Three main categories were uncovered during the analysis:

167 1) Management options for mitigating the consequences of OA,

168 2) Experiences of the digital program, with four sub-categories a) Easy to execute, b)

169 Flexibility to choose when and where, c) The importance of interacting with healthcare

170 professionals and d) Other motivating factors and 3) Perceived effects of the digital program

171 over time, with two subcategories a) Perceived effects of the program after the initial six

172 weeks and b) Reasons for continuing to participate in the program (Figure 1). Participants'

173 suggestions for improving the digital program were also analyzed.

174

175 **Management options for mitigating the consequences of OA**

176 This category entailed the experiences of the perceived consequences of OA leading to the

177 patients' eager search for a cure that would reduce their symptoms. All participants described

178 symptoms such as pain, disrupted sleep, deteriorating ability to walk, being immobile, and

179 activity limitations. Pain was the main motivation for seeking professional management. The

180 participants also found that their decreased functioning was not only affecting themselves,

181 but was also a burden on their partners and family. They were trying all sorts of ways to ease

182 the pain and to regain motor function. They were eager to try any treatment hoping that the

183 program could reduce their symptoms and improve their quality of life.

184

185 *"I felt that it was impossible to continue in this way as I was in such intense pain..." (I18)*

186

1
2
3 187 *"...you know...I wasn't able to go downtown without thinking about how I would get*
4
5
6 188 *back home again, when it was at its worst. I was also considering having surgery and*
7
8 189 *other options, but only to get better. I was feeling really bad ..."* (I12)
9

10
11 190
12
13 191 *"You take every chance for improvement that you get. In the end you know it'll be*
14
15 192 *beneficial."* (I3)
16

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18 193

19 194 **Experiences of the digital program**

20
21 195 This category includes four sub-categories; a) Easy to execute, b) Flexibility to choose when
22
23
24 196 and where, c) The importance of interacting with healthcare professionals and d) Other
25
26 197 motivating factors. In general, the participants' experiences of the program were positive.
27
28 198 They found the program very easy to execute, flexible, and motivational. The interaction
29
30 199 with the physical therapist was described as important for support and encouragement.
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32
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34 200

35 36 37 201 *Easy to execute*

38
39 202 Most participants were satisfied with the set-up of the program. The program was perceived
40
41 203 as structured, educational, and very simple to execute. Other elements that facilitated
42
43 204 participation were instructional videos, email reminders, and that the exercises were
44
45 205 individually customized with increasing difficulty, but also quickly accomplished.
46
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49 206
50 207 *"This is such a great set-up. Not only the exercises, it's really educational and you*
51
52 208 *learn what osteoarthritis is really about."* (I13)
53

54
55 209

56
57 210 *"I found it really easy to follow. It does not take long and it's really good to receive*
58
59 211 *these reminders by email"* (I18)
60

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5 213 However, a few participants perceived some difficulties in understanding how the program
6
7 214 worked. They found that the progression of the exercises was not clearly described or that it
8
9 215 was difficult to understand specific words used in the videos.

10
11
12 216
13
14
15 217 *“To me it was hard to follow in the beginning and it actually took some time before*
16
17 218 *I understood it correctly. It took like a few weeks until I really got the system. And*
18
19 219 *that was a pity I think.” (I8)*

20
21
22 220
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24
25
26 221 *Flexibility to choose when and where*
27 222 All participants acknowledged the flexibility that was associated with this digital
28
29 223 management program. The ability to execute the exercises at home, or at any place at any
30
31 224 time, without any use of equipment was highly appreciated. The ability to control the time
32
33 225 point for when to perform the exercises and not having to make a scheduled appointment at
34
35 226 a specific location, were described as an advantage compared to traditional management,
36
37 227 and were further expressed as time-saving and less stressful since participants did not have
38
39 228 to take time off from work for OA management. One participant even expressed that she
40
41 229 would never have completed such a program if it had not been digital.

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44 230
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48
49 231 *“The flexibility, that I could decide on my own when to perform the exercises was*
50
51 232 *really good. That I didn’t have any scheduled time point when I had to dress, go*
52
53 233 *out, and at this exact time point meet a physical therapist. That I could decide on*
54
55 234 *my own...” (I11)*

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59 235
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1
2
3 236 *"I don't think this is bad at all, to have it on the internet like this. I would never*
4
5
6 237 *have done it if it hadn't been digital"* (I17)
7

8 238
9
10 239 Some participants described that there were long waiting lists for traditional OA
11
12
13 240 management in primary care and that the digital program was, thus, a flexible alternative
14
15 241 that they could start at once.
16

17 242
18 243 *"Yes, it was also like, there was such a long waiting list for primary care. So I*
19
20
21 244 *thought...this...this I can start doing right away."* (I10)
22
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24 245
25
26
27 246 *The importance of interacting with healthcare professionals*
28
29 247 Receiving an OA diagnosis without any physical meeting was perceived as a bit awkward to
30
31 248 some participants. Some concerns were revealed regarding the risk of missing serious diseases
32
33
34 249 if the diagnosis was given by phone or internet.
35

36 250
37
38 251 *"It's somewhat hard to give a diagnosis over the phone. You can do it, but it's more*
39
40
41 252 *difficult and you can miss things... there could have been a tumor there..."* (I14)
42

43 253
44
45 254 The majority of the participants had a very positive experience of the interaction with their
46
47 255 online physical therapist. They described that they received fast responses to their
48
49
50 256 questions, as well as information and encouragement, and that they often received feedback
51
52
53 257 within a few hours. Some expressed that the engagement from their physical therapist was
54
55 258 valuable for support and encouragement, especially if they experienced pain during the
56
57 259 exercises. The daily contact with their physical therapist encouraged them to perform their
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3 260 exercises every day, which was also perceived as an advantage compared to traditional care
4
5
6 261 management.

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8 262
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10 263 *“I think it’s excellent to have daily contact. I think it’s outstanding. That puts*
11
12 264 *pressure on me to really do these exercises and to answer him [the physical*
13
14 265 *therapist] and to give him an opportunity to give feedback and information about*
15
16 266 *other things... You can’t go to a physical therapist every day, every day, every*
17
18 267 *day. That won’t work. They won’t have time for me, they have others to take care*
19
20 268 *of as well. “ (I12)*

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26
27 270 In contrast, some participants experienced the contact with their online physical therapist to
28
29 271 be unsatisfactory or even non-existent. They described that it could take a week before they
30
31 272 received any response, that the questions were only partly answered, or that they received
32
33 273 no answer at all. Continuous follow-up with feedback and encouragement on their
34
35 274 performance in the program was also lacking.

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39 275
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41 276 *“In the beginning they said that someone would get in touch with me on a regular*
42
43 277 *basis and things like that. But this hasn’t happened as I expected” (I9)*

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45
46 278
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48
49 279 *Other motivating factors*

50 280 The daily email reminders were typically highlighted as a motivator since they ensured that
51
52 281 participants did not forget about the exercises and pushed them to perform the activities
53
54 282 every day. Improved OA symptoms, and the measurement feedback system provided by the
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1
2
3 283 program were other factors that were mentioned as contributing to the participants'
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5
6 284 motivation to perform the exercises.

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8 285
9 286 *"It was there, popped up in my email box every day. OK, today I'll do this*
10
11 287 *exercise...it was something that pushed me. That was good I think...I needed that."*

12
13
14 288 (18)

15
16 289

20 290 **Perceived effects of the digital program over time**

21 291 This category includes two sub-categories; a) Perceived effects of the program after
22
23
24 292 the initial six weeks and b) Reasons for continuing to participate in the program. The
25
26 293 majority of the participants reported improved functioning and reduced pain.

27
28
29 294 However, some people felt no improvements and that their symptoms were the same
30
31 295 as before entering the program. Many continued to participate in the program after
32
33
34 296 the initial six weeks to maintain the positive improvements. Although the participants
35
36 297 were positive to the digital program, they suggested a broader variation of exercises
37
38
39 298 as well as follow-ups by video calls.

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41 299

44 300 *Perceived effects of the digital program after the initial six weeks*

45 301 Several participants experienced significant reductions in OA symptoms after completing the
46
47
48 302 program. Improvements commonly mentioned were reduced pain, increased flexibility, and
49
50
51 303 improved walking abilities. In many cases the symptoms were still present but were
52
53 304 perceived to have improved significantly, leading to increased quality of life and less focus
54
55
56 305 on the disease. Many described that they had recommended the program to friends and

1
2
3 306 relatives suffering from hip or knee OA, since they were satisfied with the result and wished
4
5
6 307 that more people could undergo the same management program.
7

8 308
9
10 309 *“It has helped me fantastically. I don’t think I could have walked the way I do today*
11
12 310 *if I hadn’t done this... I don’t think so... I think this program has had an absolute*
13
14 311 *crucial role in the fact that I can manage my everyday life as well as I can now,*
15
16 312 *even though I have quite big problems.” (I2)*
17

18 313
19
20 314
21
22 315 Not all participants perceived that they had reduced symptoms or improvements after six
23
24 316 weeks in the program. Some described that their symptoms were still the same or had
25
26 317 initially improved, and then worsened with deteriorating physical function and increased
27
28 318 pain. However, several of these participants still believed in the set-up despite not
29
30 319 experiencing the results they wished for. This lack of positive results was attributed to a
31
32 320 belief that they entered the program too late, i.e., that the exercises might have helped if
33
34 321 they had started at an earlier stage of the disease, or that the exercises may have slowed
35
36 322 down the disease progression.
37
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45 324 *“The sad thing is that even if I do these exercises, every day, every week, every*
46
47 325 *month, every year... nothing happens... I don’t get any better.” (I4)*
48
49
50

51 326
52
53 327 *“It felt really good in the beginning. The reason that it didn’t help me is probably*
54
55 328 *because I started too late.” (I12)*
56
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3 331 *Reasons for continuing to participate in the program*

4 332
5 333 Many continued to do their exercises after the six weeks evaluation. Perceived functional
6
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8 334 improvements and pain reduction as well as fear of the symptoms worsening were highly
9
10
11 335 motivating factors for continuing to perform the exercises. Another reason was that it might
12
13 336 help them to be well prepared for any upcoming surgery.
14
15

16 337
17
18 338 *"I believe in these exercises. I believe that exercise is good for osteoarthritis. I am*
19
20 339 *convinced. And I think... if I stop doing this... then this terrible pain will start again."*
21
22
23 340 (I8)

24
25 341
26
27
28 342 On the other hand, reduced pain and scheduled surgery were described by some
29
30 343 participants as reasons for not continuing the program.
31
32

33 344
34
35 345 *"The pain was generally reduced... and then I did not feel as motivated as before*
36
37 346 *so I quit doing the exercises... yes I did. Generally, in physical therapy, it's hard to*
38
39 347 *keep your motivation up if you don't have a lot of pain."* (I19)
40
41

42 348
43
44 349 *"I have met with my orthopedist and I'm scheduled for surgery... I feel that the end*
45
46 350 *of this problem is near. That's why I'm not performing the exercises as I should*
47
48 351 *anymore."* (I18)
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6 353 **Suggestions for improving the digital program**

7 354 The participants suggested a few possible improvements to the digital program. For
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10 355 example, many experienced that there were too few exercises with little variation, and the
11
12 356 exercises were perceived as somewhat monotonous after a while, especially if the
13
14
15 357 participants were highly active in the program, i.e., carried out exercises several days a
16
17 358 week. It was suggested that varying and/or adding more exercises would increase
18
19
20 359 motivation to perform them.

21
22
23 360 *“In the end it became a bit boring since there were so few movements... so I*
24
25 361 *added some extra on my own... It was a bit boring to do the same thing every*
26
27
28 362 *day.” (I14)*

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30 363
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33 364 Some participants that were not satisfied with the communication with the
34
35 365 online physical therapist suggested improved patient-physical therapist
36
37 366 interaction using increased feedback and encouragement. Another suggestion
38
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40 367 included follow-ups video calls or Skype to enhance feedback on the individual
41
42 368 performance of specific exercises

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45 369
46
47 370 *“You could send a video via internet and the physical therapist will then check that*
48
49 371 *you have performed the exercise and performed it correctly and correct you if you*
50
51 372 *have performed it incorrectly.” (I19)*

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55 37356
57 374 **DISCUSSION**58
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3 375 We sought to investigate participant experiences of a digital management program for hip
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5 376 and knee OA. The majority of the participants reported improvements after the initial six
6
7
8 377 weeks, such as reduced pain, increased mobility, and a sense of improved quality of life. In
9
10 378 general the participants found that the program was easy to execute. The flexibility of being
11
12
13 379 able to perform the exercises anywhere and at any time point was highly appreciated. The
14
15 380 daily contact with the physical therapist was considered very important and an advantage
16
17 381 compared to traditional care and the participants felt that the support and encouragement
18
19 382 they received was important to continue exercising. In addition, the participants suggested
20
21
22 383 more variation in the exercises and follow-up by video-calls.
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24
25 384

26
27 385 Despite international guidelines [12], many patients with hip and knee OA do not receive
28
29 386 appropriate treatment and information regarding OA management options [4, 13, 14]. Web-
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32 387 based or digital management programs have been proposed as an option for facilitating the
33
34 388 implementation of non-surgical treatment as they have the potential to reach more
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36
37 389 individuals in need of OA treatment [4]. The participants in the current study were mostly
38
39 390 positive to the set-up of the program. Being able to perform the exercises whenever and
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41
42 391 wherever they desired, without needing to take time off from work, was described as
43
44 392 valuable. Several participants also mentioned that the digital program was something they
45
46
47 393 could start doing right away instead of being put on a waiting list. They also experienced the
48
49 394 program to be educational and they felt motivated by the daily email reminders and the
50
51 395 feedback system that were provided by the program. This result is in line with previous
52
53 396 studies investigating patient perceptions of digital OA management, e.g., through internet or
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56 397 tele rehabilitation, where the participants experienced such programs to be convenient and
57
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59 398 time-saving [30, 31].
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6 400 Exercise is one of the cornerstones of OA management [12]. However, the outcome of the
7
8 401 OA management program is highly dependent on adherence to the exercises. People with
9
10 402 OA is reported to be among those with particularly poor adherence to this type of treatment
11
12 403 [32], although there seem to be good adherence to treatment delivered online in these
13
14 404 patients [33]. A recent systematic review of people with hip and knee OA identified factors
15
16 405 such as increased knowledge of the disease and benefits of exercise, reduced symptoms,
17
18 406 easy access to training facilities, and the ability to fit the exercises into daily life as facilitating
19
20 407 exercise participation, whereas long travel time and parking difficulties were considered as
21
22 408 barriers [34]. The results from the current study indicate that a digital program may facilitate
23
24 409 participation in OA management programs and eliminate some of the barriers associated
25
26 410 with exercise participation, such as access and time constraints, and further highlights the
27
28 411 importance of adequate information and education regarding the benefits of exercise and
29
30 412 different treatment options in OA. There were, however, some contrasting experiences of
31
32 413 the digital program, mostly related to perceived symptom improvement and contact with
33
34 414 the physical therapist. Future quantitative investigations may reveal if such differences are
35
36 415 related to adherence, i.e., activity level in the program. Previous research conclude that
37
38 416 including behavioral change techniques may increase adherence to exercise [35] and a
39
40 417 digital delivery may enable the patients to continue their treatment week after week to
41
42 418 further improvements and to sustain their achieved behavioral change.
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53 419
54 420 Previous research indicates that support and encouragement from healthcare staff are
55
56 421 important factors in facilitating exercise participation in people with hip and knee OA [34].
57
58 422 This was also reflected in the current study. Interaction with the physical therapist was
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3 423 another important aspect that was highlighted by the participants. Most participants had a
4
5 424 positive experience of the contact with their assigned physical therapist and they were
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8 425 highly motivated by the daily contact and the support and encouragement that were
9
10 426 provided. This result further emphasizes previous findings that a strong therapeutic alliance
11
12
13 427 can be established without meeting in person [36-38]. However, some participants were not
14
15 428 satisfied with the contact, which in turn lowered their motivation to perform the exercises.
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17
18 429 This may indicate that support and encouragement from the physical therapist are
19
20 430 prerequisites for a satisfactory experience of a digital OA management program.
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23 431
24
25 432 In accordance with studies on tele rehabilitation, [30, 31], some concerns were expressed in
26
27 433 our interviews about being diagnosed online. A few patients were afraid that they may have
28
29 434 been suffering from a more serious disease, such as cancer, and that a differential diagnosis
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31
32 435 may be difficult via the internet. It is therefore important to respond to these worries
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35 436 accordingly, and provide the patients with information that explains that OA is primarily
36
37 437 diagnosed by symptoms and signs without any use of radiography or laboratory equipment
38
39 438 [39]. Also, some participants wished to have follow-ups via video call to eliminate the risk of
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42 439 performing the exercises incorrectly. This is consistent with previous studies reporting that
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45 440 non-supervised home-based exercises can give rise to concerns regarding the correct
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47 441 performance of the exercises [5, 31, 40]. Video calls may, thus, be one way to develop the
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50 442 program further and to optimize the experiences of digital programs without any physical
51
52 443 meeting. However, the influence of video conversations needs further study.
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54 444
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56
57 445 The results confirmed the findings of previous studies, in that the participants reported that
58
59 446 the most important results of the program were improvements such as reduced pain,
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3 447 increased flexibility, and improved walking abilities [18, 19], which brought a sense of
4
5 448 improved quality of life and less focus on the disease. Interestingly, reduced pain and being
6
7 449 scheduled for surgery were two factors described as both facilitators and barriers to
8
9 450 continuing in the program. Some participants continued to exercise because they
10
11 451 experienced that the program had reduced their pain and they were afraid that the pain
12
13 452 would come back if they stopped doing the exercises. In contrast, some felt that reduced
14
15 453 pain was a reason to stop doing the exercises, as their motivation was lost when pain no
16
17 454 longer was an issue. Likewise, some participants continued to exercise since they wanted to
18
19 455 be ready and as fit as possible for a total joint replacement (TJR), whereas others quit doing
20
21 456 the exercises when they were scheduled for TJR as they believed the surgery would solve
22
23 457 their problems anyway. Pre-surgery exercise is known to improve outcomes such as length
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25 458 of hospitalization, knee range of motion, and physical function after total knee replacements
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27 459 [41] and such information is, therefore, important to include in the educational material to
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29 460 facilitate recovery after any future TJRs in these patients.
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39 461
40 462 One strength of this study is that the participants were purposefully selected, including both
41
42 463 men and women who differed in age, OA severity, physical function, and OA location (hip or
43
44 464 knee) from different parts of Sweden. However, since the participants were located all over
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46 465 Sweden, the interviews were mostly conducted by telephone or via Skype. This approach
47
48 466 may have resulted in less depth of the interviews due to a loss of visual input. Also, two of
49
50 467 the participants completed the program more than one year prior to the interviews, which
51
52 468 may have influenced their recollection of the program and thereby also the experiences
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54 469 expressed during the interviews. Another limitation may be that some demographic data of
55
56 470 the participants, such as education level, previous experience of using digital applications
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3 471 and year of OA diagnosis were not recorded. This information may have increased the
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5 472 generalizability of the results.
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10 474 Throughout the data analysis reflexivity has been considered, i.e., we have been aware that
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12 475 the pre-understanding that the authors may have as clinicians and researchers could affect
13
14 476 the data, if one is not fully aware of previous experiences [42]. All authors worked separately
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16 477 during the data processing and there were continuous discussions during the analysis aimed
17
18 478 at eliminating possible influences of previous experiences, which helped us to stay neutral to
19
20 479 the data. In addition, we have also presented a signature after each quotation to show the
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22 480 representation of our participants, and to add transparency and trustworthiness to our
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24 481 findings and interpretations of the data.
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31 482 CONCLUSION

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33 483 A digital management program for OA, including education and exercise as well as an option
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35 484 to chat with an assigned physical therapist for feedback, questions and engagement, may be
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37 485 an alternative to traditional treatment and further facilitate the implementation of OA
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39 486 guidelines in a wider community. The participants had mostly positive experiences of the
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41 487 program, the flexibility of the program with regards to location and time. Regular and
42
43 488 frequent contact with a physical therapist was deemed particularly important for a positive
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45 489 experience of the program and was also emphasized as an advantage compared to
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47 490 traditional care. In addition, the result of this study will contribute to the further
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49 491 development and improvement of digital management for OA.
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493 **AUTHORS' CONTRIBUTION**

494 Anna Cronström, PhD contributed to the design of the study, conducted part of the
495 interviews, was responsible for the analysis and interpretation of the data, and was in charge
496 of writing the manuscript. Leif E Dahlberg, PhD contributed to the conception and design of
497 the study, contributed to the interpretation of the data, and provided feedback on drafts of
498 this paper. Håkan Nero, PhD contributed to the conception and design of the study,
499 contributed to the analysis and interpretation of the data, and provided feedback on drafts
500 of this paper. Jennifer Ericson, BSc student contributed to the conception and design of the
501 study, conducted part of the interviews, contributed to the analysis and interpretation of the
502 data, and provided feedback on drafts of this paper. Catharina Sjö Dahl Hammarlund, PhD
503 contributed to the conception and design of the study, contributed to the analysis and
504 interpretation of the data, and provided feedback on drafts of this paper. All authors have
505 read and approved the final manuscript.

506

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511

512 **COMPETING INTEREST**

513 HN is a physical therapist and part-time consultant at Joint Academy and LED is the co-
514 founder and Chief Medical Officer in the corporation behind the same program. No other
515 relationships or activities exist that could appear to have influenced the submitted work.

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517 **DATA SHARING STATEMENT**

518 The datasets used and/or analyzed during the current study are available from the
519 corresponding author on reasonable request.

For peer review only

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678 **Table 1.** Characteristics of the participants

679	Characteristics	n=19
680	Age mean (min-max)	65 (45-80)
681	Sex	
682	Women n	10
683	Men n	9
684	Retired n	10
685	OA location	
686	Hip n	10
687	Knee n	9
	Pain baseline (min-max)	6.1 (1-9)
	Physical function baseline (min-max)	8.6 (1-14)
	EQ5D-3L index baseline (min-max)	0.59 (0.29-0.76)
	Activity in the program mean % (min-max)	80.7 (19-93)

688 OA=osteoarthritis, pain was assessed with the Numeric Rating Scale (NRS) from 0-10, where
 689 0 indicate no pain with higher numbers indicating more severe pain, physical function was
 690 assessed using the 30-second Chair Stand Test reflecting the number of repetitions of sitting
 691 to standing from a chair during a period of 30 seconds. EQ5D-3L= EuroQol – 5 dimension
 692 descriptive system assessing health-related quality of life - a higher EQ-5D-3L index indicates
 693 better health-related quality of life. Activity level was defined as the proportion of
 694 completed videos, exercises and questionnaires offered in the program.

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696 **Figure 1.** Overview of the categories and subcategories describing the participants' experiences of
697 the digital
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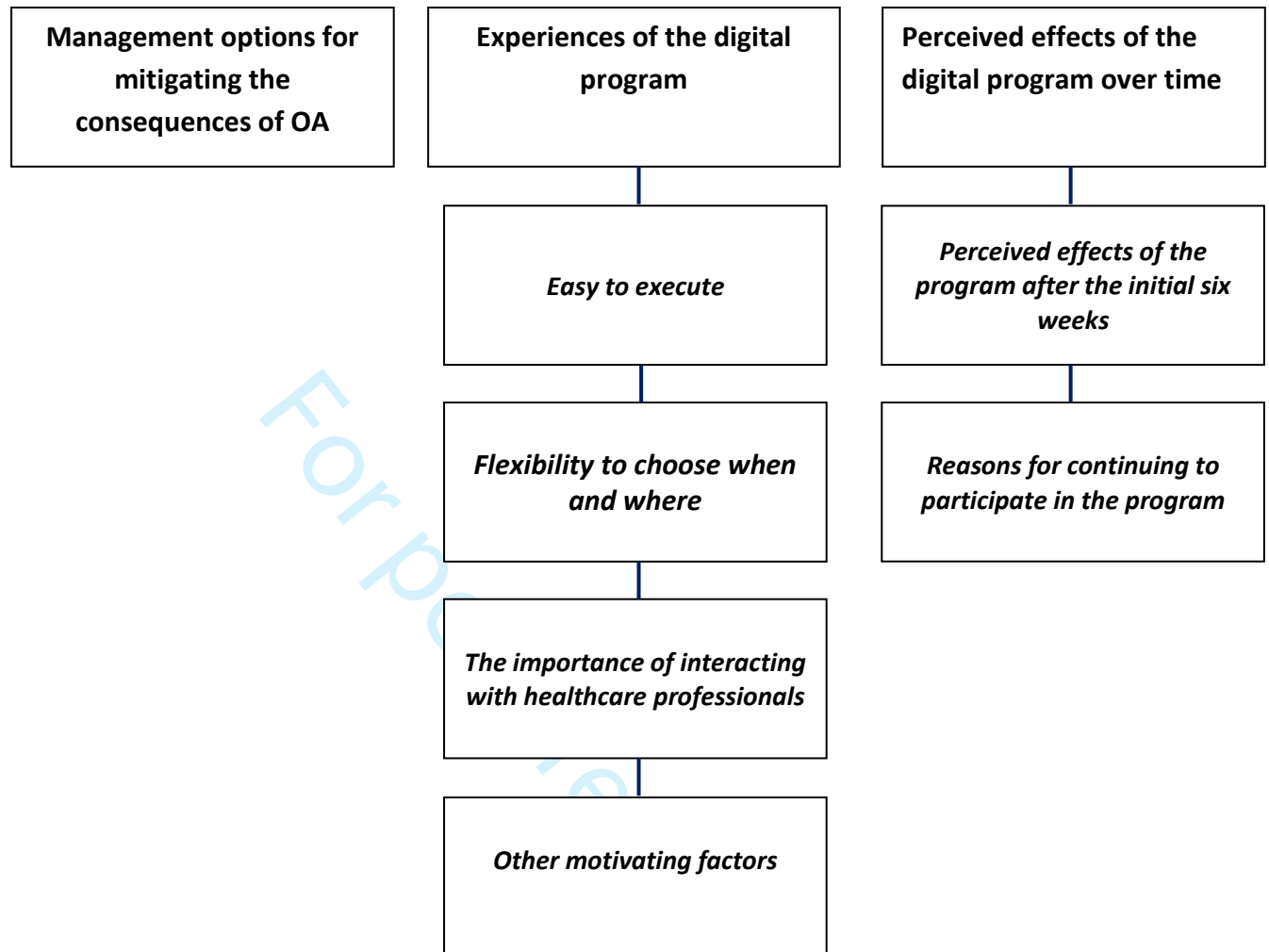


Figure 1. Overview of the categories and subcategories describing the participants' experiences of the digital management program for osteoarthritis

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3 **Appendix 1. Interview guide - Experiences of a digital management program for hip and**
4 **knee osteoarthritis** (translated from the Swedish version)
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8 How long have you had symptoms from your hip/knee?
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10 Could you describe your symptoms before joining the program?
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- 12
- 13 • How did your symptoms affect you everyday life?

14 What were your reasons for joining the program?
15

16 What were your expectations before joining the program?
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18 How did you experience the treatment?
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- 20
- 21 • Set-up
 - 22 • Exercises
 - 23 • Availability
 - 24 • Layout
- 25

26 How was your motivation for doing the activities?
27

28 How did you experience your contact with the physical therapist?
29

30 Do you experience that the treatment has altered your symptoms?
31

- 32
- 33 • In what way/direction?

34 Have you continued with the program/home exercises after the initial six weeks?
35

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- 37 • What were your reasons/motivations for continue/not continue?
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39 How do you think Joint Academy could have done a better job in assisting your treatment?
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44 At the end of the interview asking the participant to raise any subject not yet covered
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46 Throughout the interview the participants were asked to elaborate on the subject and to
47 explain or clarify the meaning and consequences of their experiences
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Appendix 2

Table 1. Examples of themes, meaning units, condensation of meaning units, codes and descriptions and concepts.

Interview and page	Themes	Meaning units	Condensed meaning unit	Code	Descriptions and concepts
2B3	Motivation	I wanted to continue because I know it's good for me. And I know deep inside that exercises will help me.	I know it will help me	Motivated by improvements	Other motivating factors
3c9	Flexibility	I had access 24/7. I could do it when it fitted me.	When it fitted me	Could do the exercises when it fitted the participant	Flexibility to choose when and where
10J4	Change in OA symptom	Yes, the pain was reduced and almost disappeared some days. I really improved so it was all positive	Reduced pain	The program reduced the OA symptoms	Perceived effects of the digital program over time

COREQ (CONsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			NA
<i>Personal characteristics</i>			
Interviewer/facilitator	1	JE & AC	7 & 22
Credentials	2	JE:BSc student, AC: PhD	22
Occupation	3	JE:Physiotherapy student, AC: Researcher	22
Gender	4	JE & AC: Female	
Experience and training	5	Basic training	7
<i>Relationship with participants</i>			
Relationship established	6	No relationship	NA
Participant knowledge of the interviewer	7	All participants had oral and written information which included that the data collection was part of her Bachelor thesis and future scientific publications.	6-7
Interviewer characteristics	8	JE & AC showed interest and empathy and gave relevant follow-up questions to encourage the participants to elaborate on their narratives.	
Domain 2: Study design			
<i>Theoretical framework</i>			
Methodological orientation and Theory	9	Systematic text condensation as described by Malterud, which is based on Giorgis' psychological phenomenological analysis (ref 21,22)	8
<i>Participant selection</i>			
Sampling	10	The participants were purposefully selecteddifferent age groups, perceived pain and physical function They were consecutively included...	6-7
Method of approach	11	Seventy three invitations with written information about the study were sent out by e-mail. Twenty-one accepted the invitation.	6
Sample size	12	Nineteen participated...	7
Non-participation	13	Two were excluded. One did not speak Swedish, one could not be reached.	7
<i>Setting</i>			
Setting of data collection	14	Mostly in their homes using Skype or telephone, two personal interviews	7
Presence of non-participants	15	None else were present besides the participants and researchers.	NA
Description of sample	16	Ten women and nine men, median age 66 (q1-q3, 57-71) years, OA joint location was either in the knee (48%) or hip (52%).	7
<i>Data collection</i>			
Interview guide	17	The interview guide and follow-up questions were pilot tested and were then subjected to minor editing.	7
Repeat interviews	18	No repeat interviews were carried out	NA
Audio/visual recording	19	The interviews were recorded.	8
Field notes	20	Field notes was taken with regard to emotinal reactions and so on.	
Duration	21	The duration was approximately 30-40 minutes.	8
Data saturation	22	Data collection stopped when no further information was added.	8
Transcripts returned	23	The transcripts were not returned to participants for comment and/or	NA

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction.	
Domain 3: analysis and findings			
<i>Data analysis</i>			
Number of data coders	24	Three authors coded the data (JE,AC,CSH)	8
Description of the coding tree	25	The coding tree was not provided.	NA
Derivation of themes	26	The themes derived from the data.	8
Software	27	No software was used to manage the data.	NA
Participant checking	28	The participants did not provide feedback on the findings.	NA
<i>Reporting</i>			
Quotations presented	29	Participant quotations was presented to illustrate the findings and each quotation was identified with a signature.	21
Data and findings consistent	30	The data was rich, varied and consistent. No triangulation was done.	21
Clarity of major themes	31	Major themes were clearly presented in the findings.	8-17
Clarity of minor themes	32	There is a description of diverse cases and discussion of minor themes.	18-21

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.